RTMENT OF METAL PROCESS
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H. L. CAMPBELL
W. A. SPIND ER
C. E. KRAU
W. W. GIL
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Welding Engineer

Reg. U. S. Pat. Office

March, 1935 Number 3

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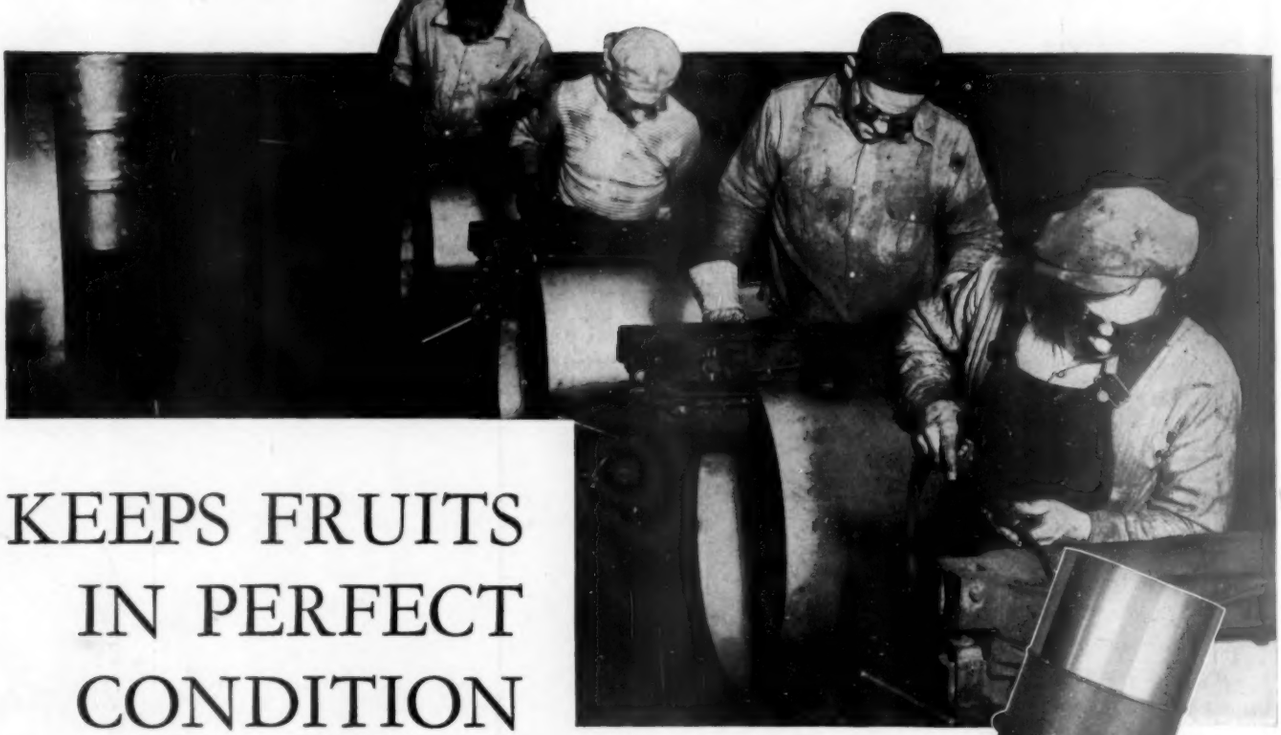
Body.

(See Page 18)

eer Business and Technical Journal of the Welding Industry

Gas welded, ENDURO-*lined* Barrel...



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Republic ENDURO long ago passed the stage where it was used merely because of its novelty and its beauty. Today, it is a valuable tool of many industries—taking the place of less noble materials in the interest of longer life and greater economy.

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Republic Steel
CORPORATION
GENERAL OFFICES · · · YOUNGSTOWN, OHIO
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MEMBER AUDIT BUREAU OF CIRCULATIONS

THE WELDING ENGINEER

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Published on the 15th of each month by The Welding Engineer Publishing Company, 608 S. Dearborn St., Chicago, Ill. Telephone Webster 7134.

G. H. Mackenzie, *President and Treasurer* — F. L. Spangler, *Editor* — L. C. Monroe, *Advertising Manager*

REPRESENTATIVES

EASTERN: T. E. Depew, American Circle Bldg., New York, N. Y. Tel. Columbus 5-7843.
PACIFIC COAST: W. R. McIntyre, 1115 Tyler St., Glendale, Calif.

Subscription, payable in advance: United States and possessions, $3 a year; Foreign Countries, $4 a year; Canada, $4 a year; Single copy, domestic, 25 cents; Single copy, foreign, 35 cents. Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

FOREIGN REPRESENTATIVES: GREAT BRITAIN—Capt. D. Richardson, 26 Winterbrook Road, Herne Hill, London; AUSTRALIA and NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand; SOUTH AFRICA—J. W. Arnison, 35a Victoria Avenue, Benoni, Transvaal, South Africa.

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· E D I T O R I A L ·

They're Complimentary Rather Than Competitive

● One can't deny that the arc and gas welding processes are competitive for certain applications, in which the results obtained with each process, and the respective costs, are so nearly the same that the use of either process can be justified with the assurance that it will be thoroughly practicable and not excessively expensive. ¶ Nevertheless, the attitude that either process is competitive with the other has often led to burdensome practices, such as profitless jobs and unsatisfactory work. The shop which is equipped to do only arc or gas welding should understand clearly the limits of the field it can serve with fairness to itself and to the trade at large. Even so, when a good job comes up, such a shop is tempted to turn all its resources and efforts toward landing it. It is bad enough when two shops of equal merit as to personnel and equipment cut prices to get work, but it is even worse when a gas shop tries to compete with an arc shop for arc jobs, or an arc shop competes with a gas shop for gas jobs. In such situations, the one-sided shop, whether it be arc or gas, should see the advantage of becoming familiar with both processes, so it can stay strictly within the limits its process prescribes, where such limits are well defined. This will often lead to the shop taking on the other process so it can broaden its service as a welding shop. ¶ Moreover, the adoption of either the arc or gas process to supplement the other sometimes leads to interesting and unexpected results. Take the case, for example, of Merton Moon, of the Moon Machine Works, of Bloomer, Wis. A year ago this time, while attending a clinic, Mr. Moon was sold an arc welder to supplement his gas equipment. He had been doing oxyacetylene welding for eleven years. With a portable arc welder for field and shop work, he expected to cut his costs by substituting electric power for welding gases wherever the job would justify it. He did cut his costs, it is true, and already the arc welder has paid for itself from the savings, but at the same time his gas consumption increased until today he uses twice as much compressed oxygen and acetylene as he was using a year ago when he bought the arc welder. Since buying the portable field welder, Mr. Moon has been doing field work that heretofore he was not equipped to do. Moreover, when he takes his welding equipment out into the field, it advertises his service and brings in new customers. Recently he took his welding units (he always carries his gas equipment on the arc-welding truck) to Downing, Wis., where he installed a smokestack and breeching—a two-day job. But others who saw his truck and equipment in Downing brought other jobs to him while he was there, so he got four-days' work out of that one town. Men like Mr. Moon no longer recognize that there is any competition between the arc and gas processes. They have acquired a clear understanding of the proper application of each process, and they use each where it is best fitted. ¶ To some it may seem like a silly idea, but many shops have found that the way to increase their gas-welding business is to buy an arc welder, if they already haven't one, and one way to boost their arc-welding business is to equip themselves with gas cylinders and torches.

The Clinic Idea Clicks

● The welding clinic has earned for itself a place in the industrial picture. With each year, the clinics grow stronger in numbers and in interest. Industry as a whole is profiting from them. ¶ The clinic in some cases is a school where any visitor is invited to handle the electrode and the gas torch, and to weld any metal he desires, or apply hard-facing, all done under competent instruction. In other cases, the clinic has been conducted as a conference, at which the foreman, mechanic, designer, production executive, or salesman is instructed in the rudiments of welding as applied to fabrication problems. Such instruction is useful not only to the fabricating plant but also to the salesman of sheets, plates and structural shapes who wants to be able to confer intelligently with his customers on their fabrication problems. The welding clinic has already become indispensable to all industries engaged in the production or repair of metal parts and structures. ¶ If the rapid growth of the clinic idea keeps up, the statistician soon will be able to lay all the clinics end to end and make them stretch from here to the moon, or announce that the sum of the visitors is equal to the population of some great metropolis. Also, the lexicographers can take note that, though the origin of the word "clinic" can be traced back to a Greek word meaning "to recline," the welding clinic does just the opposite—it helps the hesitant person to stand on his own feet, by teaching him how to make good welds or how he can use the welding processes to his benefit.

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5. ***Can be Laid Up in Successive Layers*** . . . Sectional building-up of large deposits is easily accomplished.

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The Welding Engineer

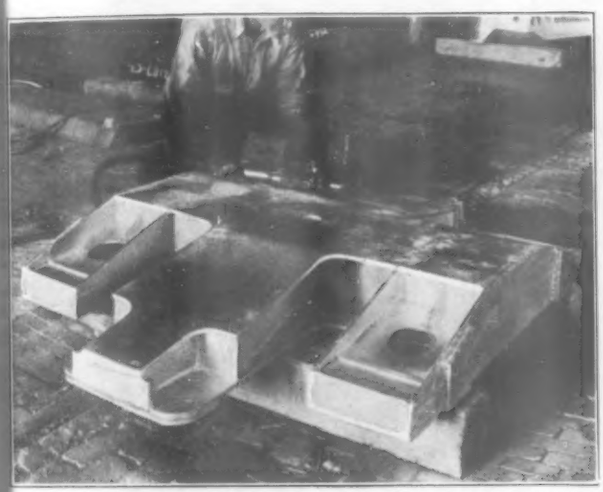
VOLUME 20 | MARCH, 1935 | NUMBER 3

Using the New Steels . . .

■ By A. E. GIBSON

Vice-President,
The Wellman Engineering Co.

The designer and fabricator should take advantage of the improved physical properties offered by the new low-alloy steels.



■

Triple Bolster for the Truck of the Sperry Rail Detector Car.

(A box-section structure in Cromansil steel, combining efficient engineering with weight-reducing, low-alloy high-strength steel. Built by the Lukenweld Co.)

■

NO OTHER development in American industrial history has had the phenomenal growth that welding has experienced in the past half-dozen years. The last six or eight years have witnessed engineering developments in the design of arc-welding apparatus which are a credit to our electrical manufacturing organizations. In that same period there has come onto the market a large number of heavily coated metal electrodes which produce welds of outstanding strength and ductility.

Industry as a whole has readily availed itself of these facilities, and, adopting them to its fabricating problems, has made its products lighter, stronger, and lower in cost than was possible with any other method of fabrication.

There is nothing new about the foregoing; it is realized by industrial fabricators employing 5 or 5,000 men. The industry producing welding apparatus and supplies has been energetic, efficient, and effective in forcing on our consciousness the savings possible with the installation and use of these products. Fabricators have "fallen" for the story, and in many instances results have proved more startling than the fantastic advertising copy and the enthusiastic story of salesmen.

It is a strange fact that the one industry standing to gain most from the development of the welding industry, particularly in the building of welded mechanical equipment, has, with two or three notable exceptions, ignored this tremendous potential market for steel until the last few years. It was not more than two years ago that the author called on the chief executive of one of the three or four largest producers of steel. He spoke to this gentleman of this new market and of his surprise that the steel industry as a whole had been content to wait out the first few years of the depression, dreaming of the return of structural building and rail tonnage to lift the heavy hand of staggering operating losses. The gentleman stated that they now realized the possibilities and were taking steps to energetically promote the building of welded equipment. This fact was true. The loss of three years, in coming to this decision, was just too bad for the industry. The start should have been made at least by 1929 instead of 1932.

Once the decision was made, the effort in education in and outside the steel industry was as effective as it was intelligent. Moss-backed engineers and operating officials, grown old in the industry, developing and operating equipment built of cast iron, cast steel and riveted parts, were bombarded by younger "new products" engineers and salesmen in the

■

2-Cu. Yd. Dragline Bucket of Welded Construction.

(Alloy-steel plate makes possible a weight reduction of 25%. Designed and built by The Wellman Engineering Co.)

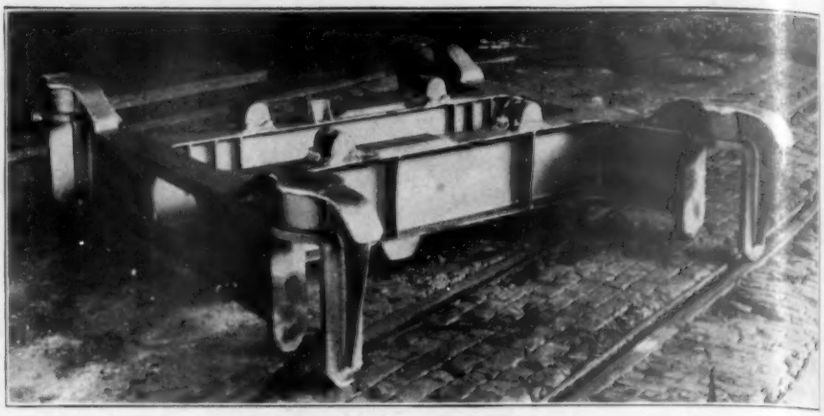
■

steel-producing industry. Lavish use of advertising space, articles and addresses on all phases of welding were given unstinted support; laboratories, both physical and metallurgical, were turned loose on the study, investigation and development of welding. The advancements of the welding art were widely publicized.

What has been the result? Within the last three years the developments made by the steel industry have been of such startling extent that designing engineers and fabricators have been left, as a whole, far in the rear. Today industry continues to build and offer to the trade equipment constructed of the material of twenty years ago and not the material of 1935. I refer to our practically exclusive use of low-carbon, low-yield, low-ultimate-strength steel instead of the new low-alloy, high-yield, high-tensile, high-ductility steels of fine welding qualities produced by nearly every steel mill in America. Steels are available with yields of 50 to 60 thousand, ultimate strengths of 80 to 95 thousand, with very satisfactory qualities of ductility, bending, impact and fatigue; steels free of the objectionable hardening qualities found in the high-carbon steels of equal physical values.

Tests Show High Strength Values and High Ductility

The writer's company recently conducted a series of tests on one of the newer low-alloy steels of some 0.25% carbon, 0.25% molybdenum, 1.40% copper—a high-tensile, corrosive-resistant steel recently brought out. With ¼-in. plate, butt welded, thermal treated to 950° F. and air cooled, yield points of about 90,000 lb. per sq. in., ultimate strengths above 110,000 lb. per sq. in., elongation in 2 in. across the weld of 25% to 30%, and 180° bends were obtained. In all these tests, using coated high-quality, alloy electrodes, the fracture occurred outside and at a considerable distance from the weld, notwithstanding the fact that the Rockwell hardness of the weld was lower than that of the parent metal. Additional tests in impact and fatigue are under way and it is not anticipated that these qualities will be anything but satisfactory.



Truck for a High-Speed Five-Car Train.
(Weighs 1200 lb., and is made of Cromansil steel plate. A fine example of light-weight welded structure. Built by the Lukenweld Co.)

Making the front page of the nation's newspapers, the new Zephyr-type passenger train, which bids well to revolutionize passenger traffic, is an outstanding example of modern engineering using modern materials. All these trains built or under construction are fabricated of the new low-alloy high-tensile steels, the stainless steels, aluminum alloys or a combination of these materials. In many instances the trucks, sills, bolsters and motor beds are of welded construction, built of low-alloy steel, permitting weight reductions effectively contributing to the efficiency of these new trains.

The remarkable work done by the Lukenweld Company, subsidiary of the Lukens Steel Company of Coatesville, Pa., in the building of welded Diesel-engine crankcases, is another example of the possibilities of weight reduction with low-alloy steels and efficient design. Older-type Diesels with a capacity of 800 hp., 350 to 400 r.p.m., weighing 50,000 lb., have been replaced with welded crankcase designs developing 1300 hp. at 700 r.p.m., weighing 22,000 lb. What this has meant to the progressive builders of Diesel engines is indicated by the remarks of a competitor who, when asked what this new low-weight-per-horsepower engine meant to the trade, said, "Everything; they have run off with the market while we sat back feeling content with our developments of ten years ago."

5-Cu. Yd. Williams Dredging Clam-Shell Bucket.
(The plate and bars are of low-alloy steel having double the strength of low-carbon steel. Designed and built by The Wellman Engineering Co.)

Weight Reduction Allows Savings in Power

In moving mechanisms where the energy required to accelerate varies with the mass to be moved, the savings in power with modern design using high-tensile steel are enormous. A possible weight reduction of 25% is modest. Naturally advantage must be taken of welding, of alloy heat-treated shafting, of anti-friction bearings, of light non-ferrous alloys, as well as building the main structures of low-alloy steels. These are the lines along which engineers and fabricators will work of their own volition, or else they will shortly face the situation where the buyer will tell the salesman to run on home, redesign his product, and come back when he has

product that is reasonable in its operating cost and performance.

The labor cost of low-weight, high-strength equipment is no higher than with low-physical-value, high-weight material. The increased cost lies solely in the base material. Efficient design, low weight, saving of pattern development and the steel-foundry code have gone a long way in equalizing the increased cost of alloy steel. The saving of power with lighter weight is a selling advantage which no purchasing agent or engineer can ignore. The light-weight train, the welded Diesel engine, the modern automobile, prove the truth of this statement.

The steel industry offers to American fabricators today the greatest forward step of the century in design. Those who are far sighted and progressive will not wait until stiff competition forces them to modernize their equipment. The adage of the early bird catching the worm was never more true than in this regard.

Approves Welding of Gravity Tanks, Risers and Towers

Approval by fire-insurance authorities of welded gravity tanks, tank risers and towers will open up a large field to the use of the fusion-welding processes. Rules for welded construction of this nature have now been recommended by the National Board of Fire Underwriters, pursuant to the action of the Advisory Engineering Council, as a basis for the acceptance of welded construction for fire-insurance rating and inspection boards and bureaus and service organizations.

These rules, dated Jan. 1, 1935, were recently issued by the National Board of Fire Underwriters, 85 John St., New York, N. Y., under the title "Tentative Rules for the Fusion Welding of Gravity Tanks, Tank Risers and Towers," and are supplementary to the National Board's "Regulations for the Construction and Installation of Tanks, Gravity and Pressure, Towers, Etc." They were prepared by a joint committee of the American Welding Society and the International Acetylene Association, and several welded structures have already been built in accordance with these provisions.

These rules apply to "the welding of steel gravity tanks supplying water for private fire protection, and to the welding of risers and towers for such tanks." Specifications cover materials, qualification tests for operators, welded joint design, workmanship, testing, inspection, and stamping.

The qualification tests follow rather closely those for A.S.M.E. Class 2 vessels, except as to dimensions of specimens. The qualification tests for operators engaged only in the welding of structural plates, shapes and tubing for tank towers, are less severe, these consisting of a wedge test and an end-fillet-weld tensile test.

The testing of the completed tank includes a hammer or impact test given while the tank is filled with water.

Exhibit of Metal Spraying and Sand Blasting, Including Many Examples of Metal-Sprayed Parts.

Johnson Is Much Alive, Despite Rumors

For several months, rumors have been in circulation that William F. Johnson, of the Johnson Welding Equipment Co., 4148 W. Nelson St., Chicago, Ill., had died of a heart stroke. Mr. Johnson's friends have anxiously been calling up his place of business to offer their sympathy, only to find that they have been made the victims of ill-conceived rumors of probably malicious intent. Anyone who has seen Mr. Johnson in recent days knows he is far from getting one foot in the grave—let alone two. "Speaking about being dead," says Johnson, "the fellow who is deliberately spreading these rumors is dead from the neck up, and if I catch up with him I'll prove to him I am no ghost."

Issues Rules for Welding Ship Hulls and Hull Parts

Rules for fusion welding of hulls and hull parts, designated as Part D of the American Welding Society Marine Code for Welding and Gas Cutting, has been approved by the American Welding Society. These rules include definitions of terms, and cover material, design, workmanship, and erection, and conclude with a caution concerning safety.

For convenience, the filler metal used is divided into two classes, each having its minimum values of ultimate tensile strength and elongation. Design values are given for each of these two classes. The test requirements for operators are based on both classes of filler metal. An operator who might not pass the more stringent Class I requirements may be able to qualify for Class II welding.

Metal-Spray Demonstration by Milwaukee Firm

A complete metal-spraying shop was set up by The Metal Spraying Corp., of Milwaukee, Wis., at the "open house" recently held by the Milwaukee School of Engineering. The "shop" included equipment of the Metal Spray Co., a 120-cu. ft. portable air compressor of the Le Roi Co., and a sand-blast generator and sand-blast cabinet of the Ruemelin Manufacturing Co. Many specimens of work were on display.

On Feb. 7th, P. G. Dennison and J. J. Chyle, of The Metal Spraying Corp., gave an illustrated lecture on metal spraying before the Associated Power and Operating Engineers Society of Milwaukee, in the Eagles Club Building.

Announces Organization of Welding Operators

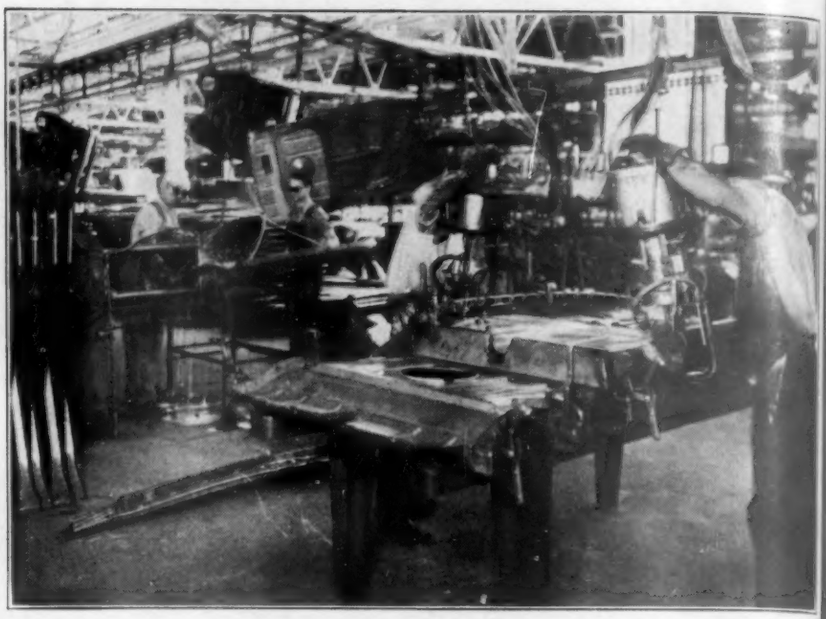
The National Association of Fusion Welders has been organized by Harry L. Marsalis, with headquarters at 317 N. Cherry St., McComb, Miss. A folder announcing the purposes of this new organization gives the following platform:

1. To bring within the organization all employes who are actively engaged in, or connected with, the welding trade.
2. To secure the establishment of a legal apprenticeship system of four years.
3. To adopt and put into operation an effective plan to stabilize employment for all our members.
4. To stimulate the education of all concerned in the need of saving from the scrap all castings which may be economically and profitably reclaimed for service.
5. To urge the need of competent supervision with practical experience to direct the procedure control of all fusion processes of welding on all classes of work.
6. To impress upon all employers the necessity of paying the full current weekly wages, giving preference in employment to members of our organization.
7. To settle all disputes not otherwise provided for by arbitration.
8. To stimulate the political education of the membership to understand their political rights and to use the ballot intelligently.
9. To cooperate with all other organizations interested in the promotion of this art, and thereby build a greater field of employment for our members.

An apprenticeship of four years is required to join the organization. No statement is made regarding fees or dues.

Making the Ford V-8 Sedan Body

■ By F. L. SPANGLER
Editor, *The Welding Engineer*



Spot-Welding the Floor Assembly.

(The front and rear floor pans and the side sills are assembled in the jig in the foreground where they are being spot welded with portable equipment by two operators. The assembly is then removed to the stationary welder in the left background, where the spot-welding operation is completed, making a rigid floor unit.)

UNDER one of the murals in the rotunda of the Ford Building at A Century of Progress were these words: "If you stabilize anything, it is likely to be the wrong thing." This admonition gives an insight into the spirit of the automobile industry—ever seeking out new and better materials, processes and methods that might make a better automobile and bring the product within reach of the earnings of almost every family in the land.

The growth of this business to become the second largest industry in this country was due to no secret rites or legerdemain. It was brought about by a diligent, unrelenting application to the problems of design and production, resulting in a continual, unceasing improvement in materials and fabrication methods — an improvement that is going on today with the same swift sureness that manifested itself during the past quarter century.

The only reason the automobile industry has not taken first place in value of product is because its growth has so increased the demand for steel that that larger and older industry has been able to maintain its preeminent position. If the automobile industry at its inception had taken its designs, materials and processes and stabilized them, the gasoline-propelled cars of today would be what is more appropriately known as "horseless carriages" than automobiles.

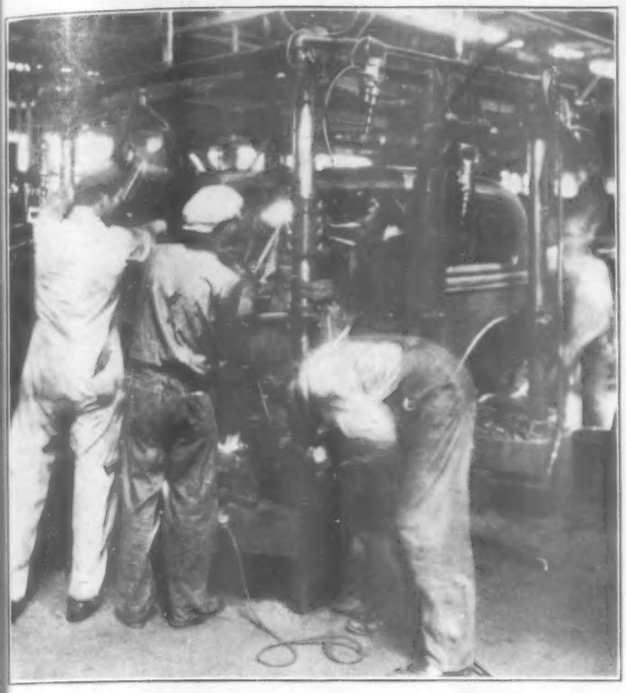
The keystone of the development in motor transportation is steel — and its handmaiden is welding. Steel of as many and varied characteristics as one finds in a motley congregation of humans. Steel that can be deep-drawn and welded, pliable steel, hard steel, steel that rings under hard blows but does not crack, steel with an endless variety of combinations of strength, ductility, hardness and resistance to reversed stresses, impact and corrosion. Bright steel, and steel that is dull and scaly. Rolled steel, drawn and forged steel, cast steel. They all have a place in the modern automobile.

The advantages of the all-steel automobile body were evident many years ago, but only recently have fabricating methods been developed which have made possible the use of steel exclusively for

Rear-End Assembly or "Balloon" of Two-Door Sedan.

(The "balloon", consisting of rear panel and right and left quarter panels, flash-welded together. The assembly shown includes the rear window moulding, vertical strainer, hinge pillars and braces welded to the wheel housings.)

The photographs illustrating this article were taken just before the new 1935 model came on the line, and therefore show the 1934 model.



Assembling a Two-Door Sedan Body in Its Specially Constructed Jig.

(The workman on the extreme left is operating a portable spot welder. The two operators with torches are welding the assembly to the peak panel and to the trim panel. At the rear of the jig, an operator is bar welding the floor assembly to the rear-end assembly.)

all members under strain. Back in 1924, the Ford Motor Company used an all-steel body, known as the Australian coupe. This was a bolted and riveted assembly. The design, however, did not prove satisfactory. It was not uncommon for rivets and bolts to work loose even before the assembly got out of the body plant.

Ford's Experience With Composite Bodies

The company used a composite steel-and-wood body up to 1932, in which year they went to the welded all-steel body. The only wood used in the welded body is for tacking purposes and not for strength. The all-welded steel body is noiseless in use. It rides over bumps and pits without any clattering. Its joints cannot open up, and hence it has no rattles or squeaks.

Now comes the story of the part that steel plays in the manufacture of the Ford V-8 body. Other manufacturers find steel indispensable in the manufacture of automobile bodies, but the use that Ford makes of steel might be taken as typical of the industry. The processes and methods described are those in use in a large assembly plant in Chicago. The description is also limited to the two-door type of sedan body, but for the other types of bodies it would differ only in a few minor details.

In the two-door sedan body, exclusive of fenders, three grades of sheet steel are used. The body is made up of four welded assemblies, and these assemblies are welded together in the assembly jig to form the body. These assemblies, named in order from front to rear of the body, are: Front-end assembly, consisting of the cowl and the pillar posts, then the floor assembly, consisting of front and rear floor pans and side sills, and at the top is the peak panel, which connects with the pillar posts of the front-end assembly, and then the rear-end assembly, consisting of the rear panel and right and left quarter panels. The grade of steel used for any individual part depends on the drawing properties desired. For the two rear quarter panels, where the deepest drawing is required, one grade of sheet is used; the rear panel, peak panel and cowl are made of another grade; and a third grade is used for the floor pans.

Welded Specimens Show 100% Strength

These steels differ in their heat treatment and in certain of their physical properties, but they have the same chemical analyses. Their elastic limit is 33,000 lb. per sq. in., tensile strength 45,000 lb. per sq. in., elongation 35% in 8 in., and hardness B-52 Rockwell, all these being average values. Inspectors check the welding of the sheets to see that the tensile strength of the weld is higher than that of the surrounding parent metal. The same welding procedure is used on all sheets, since it is claimed that the welds are not affected by the physical properties of the sheets or by the various finishes. Tested specimens made by flash and arc welding show equal strength in the welded seam compared to the parent metal, and in most cases superior strengths. Tests of spot welds made with the gun type of welder show tensile strengths above the virgin metal of equal sections.

Only assembly operations are performed by the Ford Motor Company branches in the fabricating of the all-steel automobile body. Punching and forming, and preliminary assembly work, are performed in the Dearborn plant, and then the pieces and assemblies are shipped to the Ford assembly plants for final assembly.

After the Body Is Removed From the Assembly Jig, the Final Welding Operations Are Performed.

Soldering a Lock Pillar to Obtain a Smooth Contour of the Surface.

A Two-Door Sedan Body Ready for the Painting Booth.

The front and rear floor pans and side sills are delivered to the Ford plants ready to be joined together to form the floor assembly. These parts are put in a jig and are spot welded by two operators, using portable machines, one working on each side of the assembly. The number and location of these spot welds are such as to hold the assembly together for final welding in a stationary spot welder.

In another part of the plant, a flash welder is joining the peak panel to the rear-end assembly. The assembly of the back panel and both quarter panels, to form the rear-end assembly, is also a flash-welding operation, and the unit is shipped in this assembled condition. The rear assembly also includes the rear-window moulding, spot welded into the back panel, a vertical strip known as the strainer, between the window moulding and the bottom of the panel, and three braces welded to each of the wheel housings to stiffen the assembled unit. The rear assembly also includes a hinge pillar on each side, to which the door hinges are to be attached.

All these assembled units are then inserted in an assembly jig, where the floor assembly is spot welded to the rear-end assembly and to the front-end assembly by bar welding, and the oxyacetylene torch is used to weld the peak panel to the lock pillars forming part of the front-end assembly. Oxyacetylene welding is also used to join the hinge and lock pillars and side sill to the trim panel.

The completely assembled body is then moved onto a conveyor, on which the welding operations are finished, following which the welded joints are ground off smooth, tinned, and then soldered, the solder being smoothed out to preserve the contour of the body lines.

Highway Requires Welded Under- and Overpasses

A large number of welded under- and overpasses will be required in the construction of the new Super Express Highway, running from the St. Louis suburbs to the downtown section. This is a CWA project under supervision of the state of Missouri.

The illustrations show a welded over-

Overpass With Welded Canopy and Railings.

pass, in which channels are used as supporting members and also to catch the rain water. The supporting members on the roof are also channels, and the plates are laid with a 1-in. opening, with each plate welded all around. Welding was done with a 150-ampere a.c. welder, using

View of Completed Overpass Spanning New Highway.

⅛-in. Agile Black No. 2 electrodes, designed for all-position welding. There was 1200 ft. of flat welding, and also some vertical and overhead welding. Warpage was eliminated by using a small-diameter electrode and little heat. The railings were entirely welded in sections in the shop and were assembled on the job.

Another bridge similar to this one is soon to be erected, but will be longer and will require about 1500 ft. of welding. On the bridge described, the Stupp Brothers were the contractors for the steel work, and the St. Louis Erection Co. did the erecting and welding. D. A. Clements supervised the welding.

To Hear Talks on Structural Joints and Hard-Facing

Hard-facing, and moment-resisting structural connections, will receive consideration at the meeting of the Chicago Section, American Welding Society, to be held on the 7th floor of the Hamilton Club, 20 S. Dearborn St., Chicago, on Friday evening, March 22nd. J. F. Franzen, supervisor, Air Reduction Sales Co., will give an illustrated lecture on "Armoring Machinery and Equipment to Resist Wear." The other speaker will be W. M. Wilson, research professor of structural engineering, University of Illinois, who will discuss his investigations into moment-resisting connections for steel frames for buildings, being conducted under the Fundamental Research Committee of the American Bureau of Welding.

Dr. D. S. Jacobus, president of the Society, gave a highly interesting lecture on "The Old and the New in Fusion Welding," at the Feb. 22nd meeting, held jointly with the Chicago Section of the American Society of Mechanical Engineers. The meeting on April 26th is to be devoted to railroad welding practice.

Fills Up Corrosion Pits in Sprinkler Tanks

The Standard Iron Works, of San Diego, Calif., recently completed an unusual job of repair welding in the Bridges Building. Two large tanks for a sprinkler system, each 6 ft. in diameter and 30 ft. long, installed in 1912, had during this long time in service become badly pitted from corrosion and required repairing or replacing. More than 3,600 welds were required to completely fill up these pits, according to the contractors. The job saved the owners about $3,500, as new tanks installed would have cost approximately $5,000, whereas the repair job was done at a total cost of less than $1,500. A great saving in time was also effected by welding.

Shrinkage Strains and Stresses Caused by Welding—II (Last of Two Articles)

■ By RIDDERVOLD JENSEN
Naval Architect and Welding Engineer

FOR better reference, our 10 rules of shrinkage strains and stresses (which have particular importance when peening is not or cannot be resorted to) are gathered below:

1. Use the smallest amount of weld metal possible.

2. Preferably use electrodes which yield the least heat per unit of weld deposit.

3. Preferably use methods or electrodes which produce a greater amount of weld metal in a unit time and so promote rapid welding.

4. Arrange the welding of the pieces so that they have, as long as possible, freedom to move in one or more directions.

5. Never leave a piece being welded for a long period of cooling unless the weld is built up to the full plate thickness.

6. The shrinkages may be decreased somewhat by employing a partly fixed condition, obtained for instance by weights or tack welding.

7. Distribute the heat over the length of the seam, when welding structures of large proportions, through step-backs or other methods.

8. Protect the parts being welded, during and after the welding until they are cold, against draft and wind, particularly in cold weather.

9. To prevent bending of the plate, weld if possible in such thick layers that the reverse side of the plate is assuming a red heat during welding. Use some means of restriction against bending.

10. Weld, in general, first all end connections of the plates and then the seams. Also weld at first transverse joints in the shapes, and then weld the shapes to the plates with intermittent fillet welds which cause very slight shrinkages only.

The fact, already mentioned, that the *shrinkages* longitudinal to the weld are small by no means signifies that the *stresses* longitudinal to the weld are also small. On the contrary, the reason for the very small shrinkages is, as explained, a very strong restriction by the material at both sides of the weld. This leads us to a very difficult, but important, question: Of what magnitude are the stresses in the material after the welding of, for instance, two detached plates?

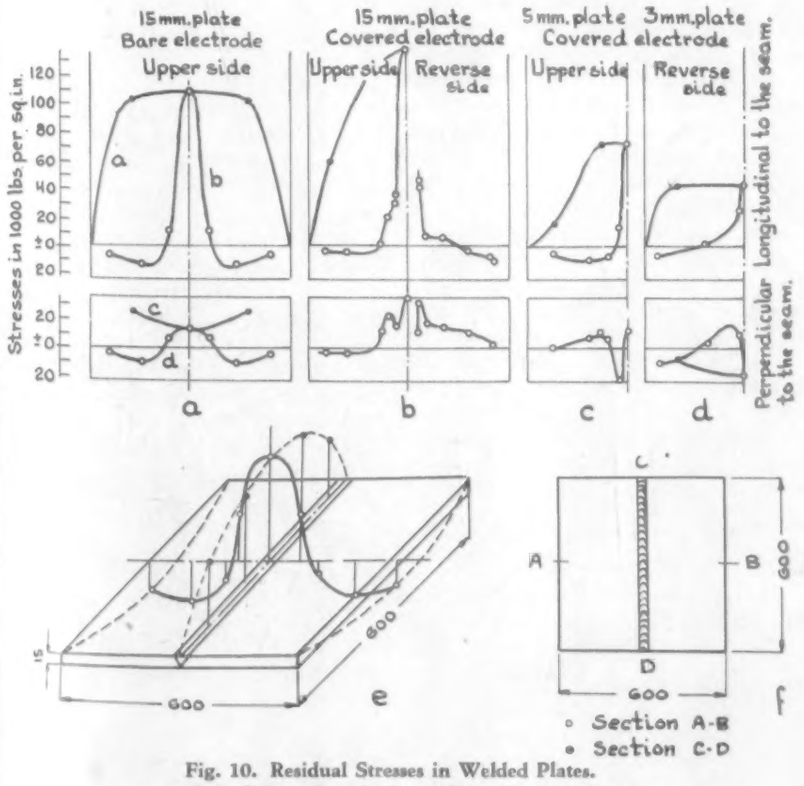


Fig. 10. Residual Stresses in Welded Plates.
Ref.: Bollenrath in *Stahl und Eisen*, No. 34, 1934.

First, we shall mention the methods at disposal for measuring such residual stresses in the material:

Measuring Residual Stresses in Welded Plates

(1) The simplest, or at least the most obvious, method is to cut up the piece which is welded, thereby releasing the stresses, which can then be calculated from the deformations which take place in the piece itself or in other parts to which the piece is attached.

(2) The distribution of the stresses at the surface of the piece may be determined by x-ray analysis. Certain distances between the atoms in their lattice arrangement in the crystals then act as the reference length, and the departure of these distances from the normal values (without stresses) is measured by the angle of bending of the reflected rays.

(3) Mathar has worked out a method consisting of drilling a hole in the piece whose residual stresses are to be determined, and measuring the deformations which occur in the vicinity of the hole during and after the drilling.

On welded plates Bollenrath has made such measurements with the method of Mathar. The plates were of mild structural steel, dimensions of 600x300 mm. each and thicknesses of 15 to 3 mm., and were tack welded with the arc, but otherwise left lying loose during welding. Both oxyacetylene welding and arc welding with bare and covered electrodes were used, and the welding was done continuously from one end of the piece to the other.

Fig. 10 shows the results of the measurements on the arc-welded plates. First, I would call attention to chart *a*, giving a picture of the stresses in a 15-mm.-thick plate welded with bare electrodes in 4 layers. The measurements shown are those taken on the upper side of the plate; the stresses on the reverse side of the plate are generally of the same character, but up to 50% and more lower. The curves give the stresses perpendicular to the weld and longitudinal to the weld in the sections A-B and C-D as indicated in diagram *f*; and they also represent the principal stresses, since the direction of these were shown to correspond fairly well with the directions of A-B and C-D.

Curve *a* in chart *a* shows the stresses in the direction of the weld in the section

C-D. These, we note, are tensile stresses, and naturally so, as the weld tends to shrink continuously but is restricted from doing so by the surrounding cold material.

Curve *b* shows the stresses in the direction of the weld in section A-B. This curve corresponds to that shown in Fig. 9, and indicates the presence of great tensile stresses in the weld itself, but compression stresses in the plate on both sides of the weld. A better picture of the condition of the stresses may be conceived by a presentment as in chart *e*, this picture, however, having reference to 15-mm.-thick plates welded by the oxyacetylene process.

Curves *c* and *d* in chart *a* show the stresses in a direction perpendicular to the weld in the sections A-B and C-D.

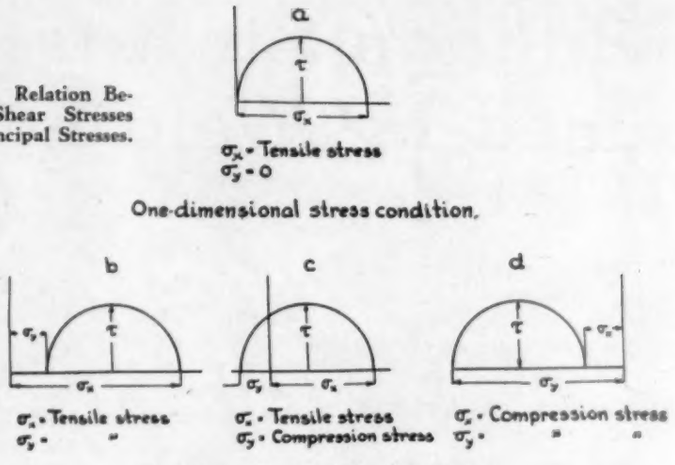


Fig. 11. Relation Between Shear Stresses and Principal Stresses.

Maximum Stresses Far Exceed Test Results

Scrutinizing the curves *a* and *b*, we note that the stresses have a magnitude of above 100,000 lb. per sq. in. (Note: Welding was done without step-backs.) These great stresses at first glance may seem utterly impossible, if we bear in mind that the plate material has a yield point of 35,000 to 36,800 lb. per sq. in. and a tensile strength of 51,500 lb. per sq. in., and the weld metal from the bare electrodes shows 42,500 to 46,000 lb. per sq. in. yield point and 56,000 to 59,000 lb. per sq. in. tensile strength.

That such high stresses may exist in these materials is chiefly due to the multi-dimensional nature of stresses. In Fig. 11, the relation between the shear stresses and the principal stresses is illustrated by the stress-circle of Mohr. We note that the value of the shear stresses depends upon the algebraic difference between the principal stresses. If, therefore, both of the principal stresses are tensile ones, as shown in *b*, greater stresses will be required to develop the same shear stresses. The yielding of the material, we know, is caused by a displacement occurring in certain slip planes of the crystals when a critical shear stress characteristic of the material is exceeded. With a stress condition as shown in *b*, the yield stress will therefore be exceeded only at higher principal stresses than in the case of the one-dimensional stress condition as in *a*, which is the usual one when testing materials.

On 15-mm.-thick plates welded with covered electrodes, Bollenrath has measured maximum stresses in the weld which are still greater than those for bare-electrode welds, and these are shown in chart *b* in Fig. 10. The reason for these higher stresses is that the weld metal from the covered electrodes had a higher yield point (56,000 to 70,000 lb. per sq. in.) and a higher tensile strength (70,000 to 82,000 lb. per sq. in.).

On the thinner plates, 5 mm. and 3 mm. thick, the stresses were lower and have a somewhat different character as charts *c* and *d*, in Fig. 10, illustrate.

As already mentioned, it is evident that the stresses in the direction of the weld must necessarily be very great. When cooling from a temperature of about 750°C. down to 0°C., the weld metal tends to shrink about $\frac{14.8\times750}{1{,}000{,}000}\times100=$ 1.10%. The elastic elongation of the steel at room temperature and under a stress, for instance, of 42,500 lb. per sq. in., according to Hooke's law is only $\frac{42{,}500}{29{,}000{,}000}\times100=0.145\%$. Hence, if the weld metal is firmly clamped the yield point will be several times exceeded during the shrinkage. During the first part of the cooling period in which the material may develop stresses, say from 750°C. and to about 400-500°C., the linear coefficient of expansion of the steel is particularly great and, besides, the yield point value small and the steel rather plastic. Undoubtedly, therefore, in this period the yield point will be exceeded; and this fact, it will be recalled, has already been emphasized as favorable to reduce warping.

Also, the restriction in the direction longitudinal to the weld, during this first period of cooling, is not exceedingly strong, as the weld on one side borders on the hot and plastic material just below the tip of the electrode and during the shrinkage may draw material from this source. Also, the value of the modulus of elasticity *E* at these high temperatures is lower and therefore a greater elongation is required to develop a certain stress.

Shrinkages at Lower Temperatures Produce High Stresses

More serious are the shrinkages which take place in the next period of cooling at, for instance, from 400° to 0°C. The steel will shrink about $\frac{13.4\times400}{1{,}000{,}000}\times100=$ 0.53%, and hence will far exceed its elastic limit. Besides, the cooling to about 200° to 300°C. leads into the blue-brittleness range of the steel, in which the material has minimum values of elongation and reduction of area.

The reader may now scrutinize these values as given in Fig. 3 and perhaps raise the objection: These concernments seem pretty untimely; even the minimum value of elongation for steel throughout the range of temperatures is about 18%, and through shrinkage only values of perhaps ½% or thereabouts are effective; we have then a luxurious margin of security which justifies the feeling that the steel has sufficient ability of deformation to endure the shrinkage.

This margin, however, is not as great as may be believed at first, even for this tough steel. The fact is that we are too used to count on the material characteristics, with which we are supplied from the testing of the materials, as being fixed and unchangeable constants, while in reality they are valid only for the condition of stress which prevailed during the testing.

The yielding during elongation of the steel is, as already mentioned, caused by a displacement in certain slip planes of the crystals when exceeding the critical shear stress, while the rupture itself is caused through destroying the cohesion of the material as the breaking stress is reached. The measurements of Bollenrath show that the weld itself endures tensile stresses in two directions, and, as explained before, the critical shear stress for yielding then occurs at much higher stresses than usual. Under such conditions of stress the material will stand only a less amount of displacement in the slip planes of the crystals—that is, a less amount of yielding or elongation—before the inner cohesion of the material, influenced by the greater tensile stresses, is destroyed and rupture occurs.

Reducing the Hazards of High Shrinkages

What can we do to keep the hazards of the shrinkages during this last cooling period, from about 400-500°C. to air temperature, as small as possible? The

following two measures at least may be recommended:

(1) The material characteristics of the weld metal as deposited should correspond with those for the steel; in particular, its yield point and tensile strength should not be substantially higher than those of the steel, as the stresses in the weld and the variations with respect to the surrounding material will then be extraordinarily great. On the other hand, the yield point and the tensile strength of the weld metal should not be considerably less than those of the steel, in consideration of the shrinkages perpendicular to the joint.

(2) The heat must be distributed as evenly as possible to avoid excessive temperature transitions and, with this, stress variations. Instructions for welding to obtain proper heat distribution have already been given in the 10 rules covering shrinkage strains and stresses.

Are those stresses dangerous which, defying all precautionary measures, are left as residual in the steel after welding?

Means for Decreasing and Dispersing Residual Stresses

It is not possible to give a general answer to this question, even when confined to mild steel of good welding characteristics. We may assume that most serious are such residual stresses in parts which are exposed to high fatigue stresses of unchangeable maximum size and direction, as for instance many parts of machinery. This is particularly so if the shrinkage stresses on the *surface* of the piece correspond to the stresses from the external forces. Structures and parts which are subject to high stresses of this character should therefore preferably be heated evenly after welding to relieve the residual stresses. The small stresses which will remain in the material after such treatment depends upon the annealing temperature and the soaking time, as shown in Fig. 12, which diagram shows the results obtained by Jennings after tests on mild steel.

For the hulls of ships, a relief of residual welding stresses by annealing is not possible. Such stresses may, however, be decreased and dispersed in another way—namely, by exceeding the yield point during loading—and we may assume that an adjustment in this manner takes place in the welded hulls of ships. A circumstance which favors this adjustment is possibly the fact that the size and direction of the external forces—and therefore the stresses which the ship is exposed to at sea—are always changing.

Considering the danger of residual welding stresses in the hulls of ships, we must recall that in riveted hulls also great residual stresses will exist in the material due to the working. So will be the case in the rivets and in the vicinity of the rivets, as well as through caulking of plate edges. Through every bending of plates great enough to cause permanent deformation, the material will possess internal stresses of a magnitude up to its yield point.

As is well known, a usual method in repairing riveted ships is to remove dents in the plate by heating the plate locally to a red heat. Although this treatment will develop just the unfavorable condition of tensile stresses in two directions, no adverse experience in service is recorded on account of this treatment.

Careful Examination Should Be Made for Shrinkage Cracks

It is of utmost importance, both for the hulls of ships and other welded parts, that no shrinkage cracks develop in the weld itself or in the material close to the weld during the welding or later on during the cooling. These cracks are particularly dangerous inasmuch as they may be very difficult to detect. If they occur on the surface of the weld, they can be found by a minute examination with the naked eye or with a magnifying glass. If the cracks go right through the material, they may be revealed through painting one side with a mixture of chalk and water and the other side with kerosene; the latter will find its way through the cracks and blur the painting on the other side. Shrinkage cracks, if any, may open up by hammering at or near the weld, or through the great forces to which the hull is exposed during the launching. After launching, therefore, it may be wise to examine all important welds closely.

Naturally, everything must be done to prevent such shrinkage cracks. By conforming with the 10 rules of shrinkage strains and stresses, we decrease as much as possible the forces which act on the material in the welding zone. These forces cannot, however, be completely removed, and it is therefore necessary that the weld metal and the material close to the weld be able to withstand overloading at all temperatures from a red heat to the cold condition.

The simplest way of testing the characteristics of the weld metal, as well as the joint itself, at these conditions is through bending tests. Test pieces are welded with a single-V weld, machined or prepared on all four sides, and bent (1) cold, (2) at a red heat, and (3) after sudden cooling from a red heat. The bending angles are noted, and the elongation of the extreme fibers are measured by lines which are scratched on both sides of the weld before bending.

This procedure may be used to compare different welding systems, but any statement outlining the characteristics necessary for different classes of work can hardly be given until more experience and experimental work have been made along these lines.

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Reprints containing both of Mr. Jensen's two articles, taken from this issue and the February issue, are available in the form of a 12-page pamphlet, 8½x11 in., at 25 cents, with special prices for quantities. Order from The Welding Enginer, 608 S. Dearborn St., Chicago, Ill.

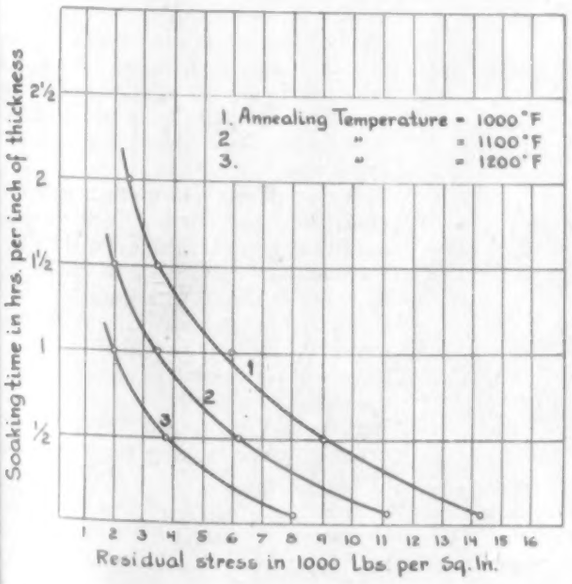
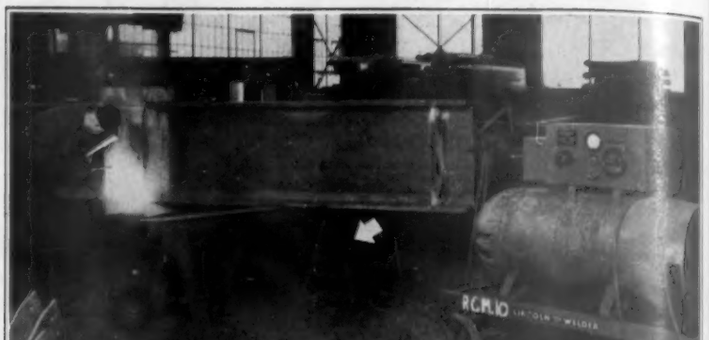

1. Annealing Temperature = 1000°F
2 " = 1100°F
3. " = 1200°F
Soaking time in hrs. per inch of thickness
2½
2
1½
1
½
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Residual stress in 1000 Lbs per Sq. In.

Fig. 12. Curves Showing Relationship Between Soaking Time and Stresses.
Ref.: Jennings in *Journal of American Welding Society*, Sept. 1931.

Being Mayor Is Only One of His Jobs

W. L. Allan, proprietor of the Allan Machine Shop, Ames, Iowa, deserves to have his name engraved on the honor roll of busy, civic-minded men. In addition to operating his machine and welding shop, he has taken an active part in the welding conferences held each year at the Iowa State College. He is also president of the Iowa Blacksmiths' Association, and is the Honorable Mayor of the City of Ames.



Welding Cable Must Be Flexible for Easy Handling, and Must Withstand Such Hard Usage as Indicated by the Arrows.

Use Care in Selecting Your Welding Cable . . .

■ By ARTHUR MADSON
Chief Instructor, School of Welding,
The Lincoln Electric Company

WELDING cable has a very definite effect on the performance of arc-welding equipment. An instance of this was recently brought to the writer's attention. A large industrial plant, doing a lot of welding, reported that the efficiency of its welding department was below that obtained in another plant of the same company using similar equipment. A welding engineer was called in. After a thorough examination, the trouble was traced to the use of cable which was excessively stiff and of wrong size. After the existing cable had been replaced there was a definite increase in weld production and efficiency.

In the design and construction of cable, flexibility and durability are of prime importance. The former factor applies more particularly to electrode cable than to ground or motor cable, because of its direct effect on the efficiency of the welding operator. With a cable of proper flexibility the operator has the advantage of easy handling, which is reflected in increased weld production per hour of welding. Where the cable is stiff, the operator becomes more fatigued and the result is greatly reduced efficiency; poor-quality welds and low production naturally follow.

The Finer the Wire, the More Flexible Is the Cable

The degree of flexibility of electrode cable is determined largely by the size of wire used—the finer the wire the more flexible the cable. Special stranding of these hair-like wires is also essential. Flexibility is still further increased when the strands are enclosed in a durable paper wrapping specially finished to allow the conductor to slip easily within its rubber insulation whenever the cable is bent.

Another factor which has a very definite bearing on flexibility is the rubber insulation of the cable. This insulation should have at least 60% pure new Hevea rubber in order to provide satisfactory flexure, durability and resistance to absorption of moisture. This rubber should be specially cured in order to obtain full advantage of its properties.

The life of the rubber insulation is greatly increased by having extra-tough, braided cotton imbedded in the rubber. This imparts added strength to the cable in much the same manner as plies strengthen pneumatic tires.

Toughness and durability are further increased by providing the exterior of the cable with a smooth finish.

Size Should Be Selected With View to Efficiency

Sizes and lengths of electrode cable are determined by the size of the welding machine in amperes. The following table shows the most efficient sizes to use with machines of various ampere ratings:

Machine Size, in Amperes	Cable Sizes for Lengths Up to 50 ft.	50-100 ft.	100-250 ft.
100	2	2	2
200	2	1	2/0
300	0	2/0	4/0
400	2/0	3/0	4/0*
600	2/0	4/0	4/0*

*Recommended longest length of 4/0 cable for 400-amp. welder is 150 ft., for 600-amp. welder 100 ft. For greater distance, cable size should be increased; however, this may be a question of cost—consider ease of handling versus moving the welder closer to the work.

The sizes of cable recommended in the above table have been determined by long experience as being the most efficient with the size of machine given. Where cable sizes other than those recommended are used, current of proper characteristics for most efficient welding will not always be available at the arc.

While satisfactory results may be obtained with sizes other than those given, it is practically always advisable to choose cable to fit the job and machine. If the cable is undersize, for example, there may be a drop of 8 volts or more in the cable itself. Thus, if you were using a welding machine designed to deliver 300 amperes at 40 volts, you would obtain only 32 volts at the arc instead of 40. Hence, it is essential to select cable of the proper size if you would obtain satisfactory welding.

Since the length of cable used also has a bearing on efficiency, the lengths recommended in the table should be followed wherever practicable. However, there will be cases in which longer lengths than those given will be required.

If Long Lengths Are Necessary, Diameters Should Be Increased

As an example, in a recent job of pipeline welding on the Pacific Coast, it was necessary to cross salt marshes. The terrain of the country made it impossible to transport the welding machines into the neighborhood of the welding. Transmission of welding current had to be accomplished through long lengths of cable. At times, as much as ¼ mile of cable was used on this job. Satisfactory results were obtained by using cable several sizes larger than would ordinarily be used.

Another instance in which it may not be possible to follow the lengths recommended is in structural work, since the operator does more efficient welding if he is not burdened with excessively unwieldy and heavy accessories. A remote-control device is of assistance in obtaining a welding current of proper characteristics at the arc without extra cables or rheostat and in spite of any line drops or losses caused by using the wrong size of cable.

In selecting welding cable it is also important to consider the factor of weight because of its influence on the

fatigue of the operator. The following table gives the outside diameter in inches and weights per 1000 ft. of welding cable:

CABLE SIZES AND WEIGHTS

Size No.	Approx. O.D., In.	Weight, Lb. per 1000 Ft.
2	.604	310
1	.644	389
1/0	.694	455
2/0	.754	544
3/0	.827	663
4/0	.959	858

Since weight increases with size, it is obvious that when a welding operator is using cable that is larger than necessary, he is merely hampered by extra useless weight, which reduces his efficiency.

As an example, No. 4/0 cable might be used where No. 2 was the proper size. In this instance the operator would be burdened with about 5½ lb. of useless weight for every 10 ft. of cable handled. Even where cable only one size too large is used, there is added weight, which, though it may not be great, is nevertheless unnecessary.

Lugs and Connectors Deserve Special Attention

For connecting the ground or electrode cable to the switchboard or control box, and for connecting different lengths of cable together, lugs and connectors are required. These parts must be properly designed and constructed so that when in place they do not induce drops and losses in the welding circuit.

Quickly detachable connectors, employing a plug-and-jack arrangement with fiber bushings over the metal parts to prevent grounding, greatly facilitate the quick connecting of welding cables in the field. These connectors can be separated by simply pulling them apart. In the field, a loose slip-knot is tied in the cable before connectors are plugged together to prevent their being accidentally pulled apart.

The extra flexibility necessary in electrode cable is not essential in ground-cable service. However, ground cable must have the same high quality as regards materials and construction, if it is to give satisfactory service at low cost. Ground cable is available in any length for welding service in sizes Nos. 2, 1, 0, 000 and 0000.

For portable motor-driven machines, it is sometimes desirable to use a rubber-covered 2-, 3- or 4-wire cable which can be disconnected from the supply lines and coiled up. Special cable is designed for this purpose. It is well protected by a covering containing a high percentage of pure rubber, to withstand severe usage.

Since all welding cable looks very much alike, something more than appearance must be considered in its selection. Undoubtedly, the wisest plan to follow is to choose cable made by specialists in the manufacture of welding equipment. When this is taken as the basis of selection, the purchaser is bound to obtain cable which is designed and constructed especially for welding service, and which, for that reason, will render highly efficient and economical service over long periods of hard usage.

Cleveland Company Builds Largest All-Welded Cranes

Two 15-ton cranes, said to be the largest all-welded steel cranes ever built, have been completed by The Cleveland Crane & Engineering Co., of Wickliffe, Ohio, and shipped to the American Sheet & Tin Plate Co. The crane girders are of 120-ft. span, and each crane weighs 240,000 lb., exclusive of motors and other electrical equipment. The cranes are equipped with a double bridge drive with auxiliary welded support girders. The only casting in either crane is a cast steel cable drum.

California Pipelines Are All-Welded

A portion of the Sunset Reservoir Supply project in the city of San Francisco, Calif., and a part of the Estero Bay pipeline, for the Standard Oil Co. of California, are shown in the two accompanying illustrations.

The joints of the San Francisco project are of the bell-and-spigot type and are welded both inside and out. The line is 8900 ft. in length and the pipe 54 in. in diameter and ⅞ and ⅜ in. in thickness. The general contractors were Barrett & Hilp, of San Francisco.

The Estero Bay project consists of a 12-in. oil line laid over the Coast Range. In many places the country was so rough and inaccessible that welding cables 1500 to 2000 ft. long had to be used. This line has butt joints without a backing-up ring. Lindgren & Swinerton, Inc., of San Francisco, were the general contractors.

The welding of both lines was entirely by the electric arc, and was done by H. C. Price, Inc.

Estero Bay 12-In. Oil Line Being Laid Over the Coast Range.

54-In. Sunset Reservoir Line.

Program of March Meeting of Los Angeles Section

An interesting and varied program is scheduled for the March meeting of the Los Angeles Section of the American Welding Society. Earl Gard, development engineer for the Union Oil Co., will give a talk on the use of different metals in the oil industry. Mr. Cameron, sales engineer of the same company, will give a demonstration of the process of dewaxing lubricating oils. Motion pictures of fabrication and erection of pressure vessels used in the oil industry will be shown by W. L. Refenbrick. A talk on "Non-Ferrous Metals" will be given by W. C. Swift, sales engineer for The American Brass Co. The meeting will be held on Thursday evening, March 21st, at the Golden State Cafeteria, 1150 Towne Ave., in Los Angeles.

In the announcement of the February meeting of the Los Angeles Section in last month's *The Welding Engineer*, a talk by Paul Jeffers was inadvertently omitted. Mr. Jeffers, consulting engineer and past chairman of the Section, gave a comprehensive explanation of "Residual Stresses in Welding," and used blackboard sketches to clarify important points.

News of the **Welding Conferences and Clinics**

Omaha Welding Company to Hold Welding "Confab"

A 3-day "Welding Confab" is to be held by the Omaha Welding Co. in their new building at 1501 Jackson St., Omaha, Nebr., on March 28th to 30th. There will be practical gas and arc welding demonstrations, individual instruction, and hard-surfacing exhibits and demonstrations. Companies assisting include the Smith Welding Equipment Corp., Hobart Bros. Co., General Electric Co., Haynes Stellite Co., Central Steel & Wire Co., American Manganese Steel Co., Titan Metal Manufacturing Co., Aluminum Co. of America, Will-Weld Manufacturing Co., Sani Products Co., American Steel & Wire Co., Linde Air Products Co., and others. Visitors are invited to bring in their welding jobs, including equipment for repairing and plow shares for hard-facing.

* * *

Portland, Ore., to Have 3-Day "Welding School"

A 3-day "Welding School" is to be held by J. E. Hazeltine & Co., 2nd and Ash Sts., Portland, Ore., on March 21st to 23rd. The program includes exhibits and demonstrations, in which the company will be assisted by manufacturers of welding equipment and supplies.

* * *

Grand Rapids Firm Will Hold Welding Clinic

Michigan Gases, Inc., Grand Rapids, Mich., will hold its 1935 welding clinic at 436 Division Ave. South, on March 27th to 29th. With increased space, the show will be larger and more complete than that of last year. The popularity of last year's show and the many requests for another show have given the company encouragement to repeat. Grand Rapids was the first city in Michigan, outside of Detroit, to have such an exhibit. The company reports a 50% increase for 1934 in volume of sales, and the first two months of 1935 have shown a sharp advance over the same months of 1934.

* * *

University of Wisconsin to Hold Conference in May

A welding conference will be held at The University of Wisconsin, Madison, Wis., under the auspices of the Department of Mechanical Engineering, on May 2nd and 3rd. Manufacturers and dealers in welding equipment and supplies are invited to participate with demonstrations and exhibits. A plan showing the layout of booths and giving the rental prices can be obtained from J. M. Dorrans, assistant professor of mechanical practice, who also has charge of preparing the program.

* * *

School Promotes Weekly Meetings on Welding

Every Wednesday evening a welding meeting is held by the Welding Institute of the Milwaukee School of Engineering, 1020 N. Broadway, Milwaukee, Wis., which is addressed by some prominent speaker. On March 27th, W. B. Keelor, of the Ingersoll Steel & Disc Co., Chicago, will lead the program with a talk and demonstration on the welding of stainless-clad steel. A talk by Charles Lamb, of The American Brass Co., Kenosha, Wis., is scheduled for the meeting on March 20th; he will deal with copper welding.

The third of this series of meetings was held on March 13th and attracted almost a hundred welders of metropolitan Milwaukee, including a number from Racine. The main talk was on "Opportunities in the Welding Field," and was given by F. L. Spangler, editor, *The Welding Engineer,* Chicago. An added attraction was a practical demonstration on electricity for welders, given by Oscar Werwath, president of the School.

On previous mid-week meetings, cast-iron welding was demonstrated in cooperation with the Harnischfeger Corp., and shielded-arc welding through the courtesy of the J. D. Adams Co.

Prof. Roy F. McCall, head of the Welding Department of the Milwaukee School of Engineering, is in charge of these Wednesday evening meetings, which are open to the public. The attendance and interest are growing with each meeting.

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Ryerson Holds Welding Clinic for Their Salesmen

A welding clinic at the Chicago plant of Joseph T. Ryerson & Son, Inc., held on the evening of March 1st, was attended by 140 of the company's salesmen from throughout the north central states. All those present were served a dinner in the company's cafeteria just before the meeting.

A program of considerable variety was given. H. G. Dent, of the Ryerson company, presided. A talk outlining the elements of arc welding, including descriptions of equipment and procedures, was given by Edward Walters, of the Wilson Welder & Metals Co., Inc., Electrical Division of Air Reduction Sales Co., which was followed by demonstrations of metallic-arc welding of steel and carbon-arc welding of copper, with the arc

View of Group Attending First Welding

Displays and Demonstrations Were Features of the Commercial Gas Co. Clinic at Minneapolis.

thrown on a screen, together with the dial of a voltmeter in the welding circuit, to show the relationship between arc length and type of rod on the one hand, and arc volts on the other.

A demonstration with liquid oxygen, given by Paul Burns and R. F. McNutt, of the Air Reduction Sales Co., was of great interest. This was followed by motion pictures in black and white and in natural colors of the metallic arc, with explanations, by Robert W. Holt, of the Chicago Steel & Wire Co. Some matters regarding codes and regulations pertaining to welded construction, as well as specifications and qualification tests, were explained in a brief talk by F. L. Spangler, editor, *The Welding Engineer*.

The meeting closed with an open forum, which gave an opportunity for everyone to put questions to the speakers.

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Good Attendance at Ohio Welding Conference

The interest in the Fourth Annual Welding Conference and Exposition, held at The Ohio State University, Columbus, Ohio, on Feb. 28th and Mar. 1st, was far greater than in any conference the University had ever held, states Prof. O. D. Rickly, who had charge of arrangements. Exhibitions and demonstrations were given by 28 different firms, and the four technical sessions had an average attendance of 111. At the "open house," held on the evening of Feb. 28th, visitors thronged the shops. The total registration was 736, including students.

Commercial Gas Company Holds Annual "Confab"

A 4-day welding clinic under the auspices of the Commercial Gas Co., Minneapolis, Minn., was held on March 13th to 16th in the Westinghouse Building, 2303 Kennedy St., N. E., Minneapolis. The registration totaled 1555, representing an increase of 309 over last year's figure of 1246. Assisting the Commercial Gas Co. were 26 manufacturers of welding equipment and supplies handled by the company. Many of the visitors availed themselves of the opportunity to make weld coupons, test them in a tensile machine, and examine the weld under a microscope.

A great many jobs were brought in from the outside for repair, including cylinder blocks, cast-iron boiler sections, and smaller parts. Cylinder blocks with cracked valve seats were welded, the valve seats built up, and then machined off smooth. Many castings were preheated and welded. Ample opportunity was given everyone to handle the arc and torch, with instruction given by a Commercial Gas Co. representative.

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High Interest Shown at Texas School's First Conference

The first welding conference to be held at the Texas Technological College, Lubbock, Texas, on Feb. 14th and 15th, represented the best initial effort along this line that they had ever seen, in the opinion of many of those present who have been attending welding conferences for many years. It is planned to make the conference an annual event. Ninety-five per cent of those in attendance expressed a desire to attend again next year. The registration was 294, exclusive of students. The total mileage covered by those present in getting to and from the conference probably exceeds that of any other conference of its kind ever held. The visitors showed a high degree of interest and participated freely in the discussions following the talks. The spirit of the conference was admirably expressed by Dr. Bradford Knapp, president of the College, in the welcoming address, when he said, "There is nothing greater than the ability to do one thing skillfully." The talks and speakers were:

Welcome address, by Dr. Bradford Knapp, president of Texas Technological College.
"Welding Machines and Their Application," by Willis C. Brown, mid-continent representative, Hobart Brothers Co.
"Pipeline Welding," by L. D. Suggs, Magnolia Airco Gas Products Co.
"Safety in Welding and Handling of Oxyacetylene Equipment," by M. J. LaDue, Southwestern district manager, Bastian-Blessing Co.
"Alternating-Current Welding with Heavy-Coated Electrodes for High-Quality Work," by R. W. Van Kirk, welding specialist, Southwestern district, General Electric Co.
"Hard-Facing Agricultural and Excavating Equipment," by R. K. Hughes, process service engineer, Haynes Stellite Co.
"Welding of Aluminum," by Edward B. Wilber, Aluminum Co. of America.
"Structural-Steel Welding," by E. W. Hanna, Welders Supply Co.
"Welding Stainless Steels," by V. W. Whitmer, welding engineer, Republic Steel Corp.
"General Oxyacetylene Welding Practice," by H. O. Green, The Linde Air Products Co.
"Facing Facts in Job Shop Costs," by L. C. Monroe, advertising manager, *The Welding Engineer*.
"Long-Arc Welding of Copper and Its Alloys," by W. C. Swift, service engineer, The American Brass Co.
Motion pictures: "Typical Aluminum Welding Practice," "Making It Tough" (illustrating manufacture of steel), and "Oxyacetylene Welding and Cutting in Production and Repair."

Technological College, Lubbock, Texas.

Book Reviews

BOOK OF A.S.T.M. TENTATIVE STANDARDS. 1934. 6x9 in.; 1257 pages; replete with illustrations and tables. Paper binding; price, $7.00. Cloth binding; price, $8.00. Published by American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa.

The 1934 edition of this book contains 236 tentative specifications, methods of testing, definitions of terms, and recommended practices covering materials of engineering and the allied testing field. Twenty-five of these standards relate to ferrous metals and 25 relate to non-ferrous metals, while 11 are general testing methods. The other standards apply to non-metallic substances. Forty-eight standards are included for the first time, in this edition, while some 60 were revised this year and are given in their latest approved form.

New tentative specifications, published for the first time in this 1934 edition, cover the following ferrous and non-ferrous materials: Electric-fusion-welded steel pipe for high-temperature and high-pressure service; alloy-steel castings for valves, flanges and fittings for service at temperatures from 750° to 1100° F.; and for the same temperature range, seamless alloy-steel pipe; sheet copper-silicon alloy; copper-silicon alloy rods, bars and shapes, and plates and sheets; also, magnesium-base alloy ingot for remelting, and magnesium-base alloy die castings.

To facilitate the use of the book, a complete subject index has been included, listing items under the materials and subjects to which they apply; and two tables of contents are given, one listing the standards in the order they appear (grouped under general subjects) and the second listing the items in numeric sequence of serial designations.

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PROCEEDINGS OF THE INSTITUTION OF WELDING ENGINEERS, Nov. 1933-Mar. 1934. 5¾x8 in.; 157 pages; 90 illustrations. Board binding. Published by The Institution of Welding Engineers, Ltd., 30 Red Lion Square, London, W.C.1, England.

This volume consists of six papers which were read before meetings of the Institute in 1933 and 1934. The titles and authors of the papers are: "Electric Welding in 1933," by A. C. Croskell; "Stainless Steels and Their Treatment," by F. Leverick; "The Application of Arc Welding to Shipbuilding," by H. W. Townshend; "The Development of Welding as Applied to Boiler Drums and Steam Receivers," by C. H. Davy; "The Collation of Research and Application for Welded Fabrication," by H. W. Hawkins; and "Proposed and Applied Methods of Ship Construction by Welding," by N. Milne-Hunter.

PRACTICAL EVERYDAY CHEMISTRY. 5½x8¼ in.; 300 pages. Cloth binding; price, $2.00. Published by The Chemical Publishing Co., 1450 Broadway, New York, N. Y.

This book, containing hundreds of chemical formulas, tells the composition of, or methods of making, fluxes, solders, antiseptics, anti-freezes, polishes, cleaners, and a large number of other products. Those who dabble in chemistry will find this book useful; those who don't will feel an urge to do so and try out some of the formulas suggested.

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LA SOUDURE A L'ARC ELECTRIQUE (Electric-Arc Welding). Volume I, General Characteristics; 8½x11 in.; 203 pages; 216 diagrams and 51 tables. Cloth binding. Volume II, Structural Steel, With Notes on Gas Welding; 8½x11 in.; 285 pages; 451 illustrations and many tables. Cloth binding. Published by l'Office Technique pour l'Utilization de l'Acier, 25 Rue du General-Foy, Paris, France.

These two volumes, in French, were prepared by the French Institute of Steel Construction, briefly known as OTUA. Volume I discusses the general characteristics of the arc-welding process as applied to any field of industry. Volume II is restricted to structural steel and also contains about 50 pages of information on gas cutting. Both volumes are printed in large, clear type and are well illustrated by charts and diagrams.

Volume I treats of definitions and symbols, principles, technique for both manual and automatic welding, preparation of work, characteristics of weld metal, testing and inspecting, arc-welding equipment and electrodes, and calculations for sizes of welds.

Volume II is divided into three parts, relating to general principles, examples of welded joints, and gas cutting, respectively. It describes current practices in various countries.

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THE NEW ARC WELDING MANUAL AND OPERATOR'S TRAINING COURSE. By W. J. Chaffee. Second edition; 5½x8 in.; 94 pages; replete with illustrations and tables. Flexible binding; price, $1.00. Published by The Hobart Bros. Co., Box U-35, Troy, Ohio.

This book deals with the fundamentals of arc welding and is written in a clear style that can be easily grasped by practically all students or beginners. The many illustrations add greatly to the readability of the book, and some of them arouse the interest of the reader through showing unusual welding jobs or field welding being carried on in picturesque surroundings. The metallic arc, the equipment and accessories used, types of joints, welding of various ferrous and non-ferrous metals and alloys, strength of welds, and speed and cost of welding, each is dealt with in its individual chapter. The last three chapters are devoted to a training course with exercises. Altogether, this is a book that the newcomer in the arc-welding field will refer to frequently and value highly.

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AUTO POWER. By S. W. Duncan. 6x9 in.; 56 pages; 44 illustrations and 3 tables. Paper binding; price, $1.00. Published by S. W. Duncan, 408-W South Hoyne Ave., Chicago, Ill.

This book includes detailed instructions, with diagrams, on the rewinding of motors and generators to obtain different characteristics. Those who want to make their own electric welders will be interested in the details of how to change a 12-volt Dodge generator into a welder, a description of a reactor for welding, and the chapter on the characteristics of d.c. generators and what to look for in the case of trouble. Details are given for changing d.c. generators to a.c., winding automobile armatures, putting a new winding on an old frame, etc. Diagrams make it easy to follow instructions and not go wrong. A chapter of definitions is included.

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IF YOU WANT TO GET AHEAD. By Ray W. Sherman. 5x7½ in.; 186 pages. Cloth binding; price, $1.50. Published by Little, Brown and Company, Boston, Mass.

Mr. Sherman, a very successful writer and editor, spent some thirty years in studying the reasons why some men make more money than others. He found that the things to which these men attributed their success were not really the things that counted, but that their success has been due to little things that ordinarily are not thought of as being important. "Do the things you already know you ought to do and stop doing the things you already know you ought not to do." That is Mr. Sherman's theme, and he explains in convincing and clear style why those who follow it will better themselves. The book is easy to read, and many human-interest illustrations are cited.

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THE RIGHTS OF EMPLOYERS IN THE INVENTIONS OF EMPLOYEES. By Charles F. Murray. 4½x6¾ in.; 23 pages. Paper binding; price, 15 cents. Published by C. F. Murray, Monadnock Block, Chicago, Ill.

A pamphlet of this size can't do much more than indicate the attitude of the courts in interpreting the law as it relates to patents, but the author gives a sufficiently clear explanation of the distinction between valid and invalid, and fair and unfair contracts, and the rights of contracts—both expressed and implied—as well as the responsibility of an invention, as between employer and employee, that the reader can sidestep many errors that he would be likely to fall into if he acted on his own judgment without knowledge of the law. This booklet is not intended to answer all questions that might arise concerning the relations between employer and employee in applying for

patents, but it will aid the parties concerned in understanding the interpretation of the law and may cause them to realize the importance of *knowing* the law before acting. The publisher, C. F. Murray, has a certain number of copies of this pamphlet for free distribution.

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UNEMPLOYMENT INSURANCE; LESSONS FROM BRITISH EXPERIENCE. 6x9 in.; 30 pages; 4 charts and 3 tables. Paper binding. Published by the National Industrial Conference Board, Inc., 247 Park Ave., New York, N. Y.

In view of current consideration of problems of unemployment relief and compensation in the United States, this report performs a valuable service in analyzing the British experience along this line and pointing out the pitfalls in the original British scheme, which made necessary radical changes. This report is not an argument against unemployment insurance, though it explodes some of the prevailing views regarding the benefits of this type of relief, and indicates that certain supplementary action is necessary with any compulsory scheme of unemployment relief, if we would avoid the unfortunate aspects of the British scheme.

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THE THIRTY-HOUR WEEK. By Harold G. Moulton and Maurice Leven. 6x9 in.; 20 pages. Paper binding. Published by The Brookings Institution, Washington, D. C.

A clear analysis is given of the philosophy which is at the base of the demand for a 30-hour week. The authors analyze the effect the 30-hour-week measure would have on production, on the level of prices, and on the welfare of the various economic classes, and conclude that the result would be altogether different from what the proponents of the 30-hour week expect. In conclusion, it is made clear that the proposed measure would prove detrimental to the interests of the laborer as well as other classes, it would intensify the depression by decreasing efficiency and output, and would freeze the possible volume of production below the level required to give all the people the goods they desire.

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FACTS ABOUT UNEMPLOYMENT COMPENSATION. Prepared by the Committee on Social Legislation of the National Conference of Business Paper Editors and The Associated Business Papers, Inc. 8½x11 in.; 9 pages. Paper binding; price, 10 cents. Copies may be obtained from The Associated Business Papers, Inc., 330 West 42nd St., New York, N. Y.

This report is an examination and exposition of various plans in force or contemplated, looking toward an alleviation of the consequences which accompany involuntary unemployment. The word "compensation" is used rather than "insurance," since these proposals, though generally referred to as "unemployment insurance," are not that, in a strict sense of the term. Consideration is given to the Interstate Commission recommendations, the Wisconsin law, the "American Plan," the Massachusetts Commission proposal, the Deane plan, company plans, the Rochester plan, recommendations of the President's committee, and the Wagner-Lewis bill. Great Britain's experience along this line is also briefly reviewed. Some of the data are correlated into tables. This report is limited to "facts," as the title indicates, with no opinions or conclusions implied or expressed.

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FACTS ABOUT OLD AGE SECURITY. Prepared by the Committee on Social Legislation of the National Conference of Business Paper Editors and The Associated Business Papers, Inc. 8½x11 in.; 17 pages; 9 tables. Paper binding; price, 10 cents. Copies may be obtained from The Associated Business Papers, Inc., 330 West 42nd St., New York, N. Y.

This report outlines the problem of old-age security, discusses its social and economic aspects, reviews various pension plans already established or proposed in the United States, analyzes the cost of these plans in the light of limited actuarial experience, and points out types of legislation enacted in foreign countries looking to a solution of the problem. This is essentially a factual presentation of the problem and of legislation and plans arising therefrom, and the reader is left to draw his own conclusions.

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PRODUCT DEVELOPMENT. 8x11 in.; 23 pages. Paper binding. Published by the Policyholders Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York, N. Y.

An increasing number of manufacturers are turning to product development or product improvement as a means of stimulating sales and enlarging profits, this report points out. Through the cooperation of 75 companies representing a cross-section of industry, current practices with reference to product development are described.

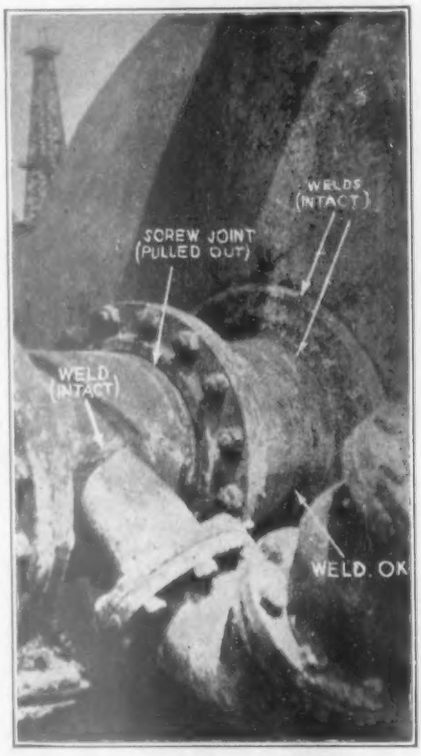
Sales or service men are found to be a fertile source of ideas for new products, probably because of their close contact with users. Some companies obtain suggestions from general employees which have been found useful in developing new ideas. An automobile manufacturer goes directly to the consumer, on the theory that "there is only one person qualified to say just what the motorist prefers and that person is the motorist himself."

The survey reveals that many companies, in the selection of ideas for development, give attention to such considerations as: (1) whether the product is suitable for marketing to established sales outlets, (2) whether it can be fabricated with existing plant and equipment, (3) whether it will overcome seasonal dullness, and (4) whether the potential market is worth cultivating. The part played by research organizations and laboratories in developing products is discussed, and methods for testing consumer acceptance are analyzed.

Welds Hold But Threads Fail in Plant Explosion

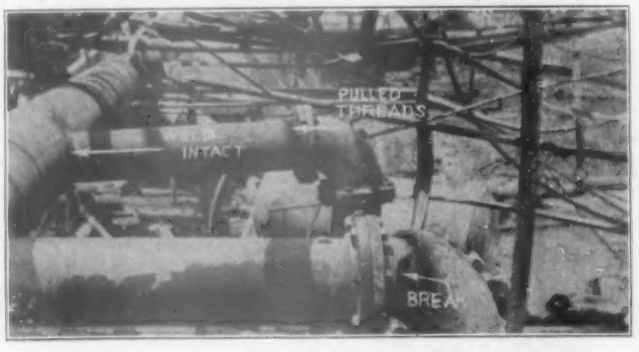
By W. E. ARCHER

From the charred ruins and tangled mass of bent steel and piping—the result of a terrific explosion a few months ago in a natural-gasoline plant situated in the Signal Hill oil field of California—has come some very striking in-



Main Lead Line From a Large Tank.

(All four welds are intact, while the one screwed connection is pulled out. Had this job been a welded one throughout, much of the damage in this particular portion of the plant would have been avoided.)



Main-Line Pipe and Connections.

(Where the smaller pipe is connected to the large main, no failure occurred, but at the bends in the center of the photograph can be seen two failures: The upper one is a screwed joint, the threads of which are stripped, while the other (in the foreground) is a break in the cast bend at the flanged connection. Welding would likely have prevented both failures.)

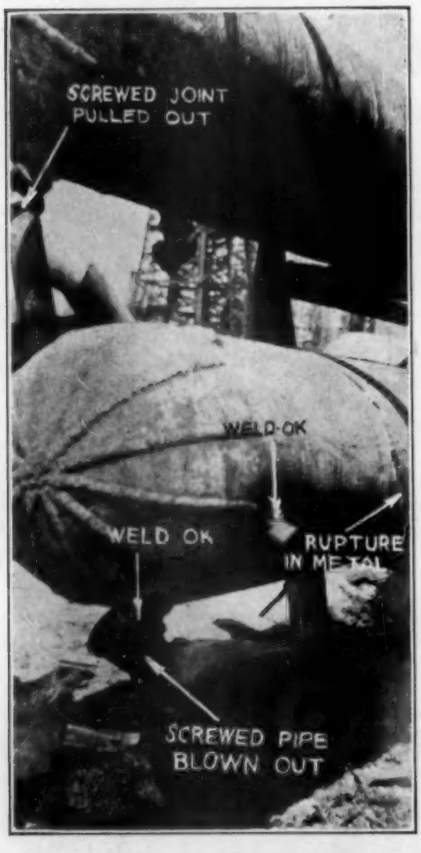
formation which illustrates forcefully the superiority of welded over threaded connections. In this instance, if in a few particular places welded joints and fittings had been used instead of screwed ones, a much smaller amount of damage would have resulted from the explosion, and doubtless some, if not all, of the ten lives which was the toll of the tragedy, might have been spared. These facts were brought out by engineers and others of authority who were familiar with the plant.

Three photographs (obtained with some considearble difficulty occasioned by objections of investigating committees, etc.) are shown herewith and illustrate some of the points in favor of welded construction over bolted cast fittings and screwed joints.

Many illustrations of the efficiency of welded joints and fittings in another section of the plant where much more smaller-diameter piping was used, were in evidence; but, unfortunately, photographs of these were not obtainable. It was said that not a single failure was detected in the welded joints in all of the twisted and mangled mass of pipe in that portion of the plant.

It should be stated, in fairness, that a few failures occurred in some of the welds of a battery of old tanks in the plant. These tanks were built elsewhere than at the plant, and years before the plant itself was erected, and of course before the more recent high-tensile, high-ductile arc-welding methods were available. Being thus moved into the plant (in all probability, as a matter of economy) when the plant was built, they had been allowed to remain in use up to the time of the explosion. But to those familiar with the facts in the case, the failures in these welds were in no way a reflection on welding.

A close inspection by competent officials failed to reveal a single failure in any of the welds made in any department of the plant since its erection. This includes all maintenance and improvements, repairs, etc., to the plant during the many years it has been in operation and during which time much welding was necessarily done in all departments.



Two Air-Receiver Pressure Tanks for Motor Starting.

(A rupture is evident well back from the end of the lower tank and at some distance from the nearest weld. All welds in the bull-plug end of this vessel are intact. Of the several small connections leading to these tanks, most were of the screwed type and all of these were blown out, whereas all welded joints and fittings remain intact and in perfect condition. This was the true condition throughout the plant.)

Get "*H. O. T.*" on Welding

■ By H. O. T. RIDLON

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

The Distributors Show Their New Stuff

The Ohio State Welding Conference at Columbus, Ohio, held Feb. 28th and Mar. 1st, sure had a swell turn out. Welders from near and far were there and showed great interest not only in the displays but also the lectures. Among the distributors who were showing new things were Lincoln with their new a. c. welder; another new machine by Ideal Electric Co., which looked like a virtual power house; P&H-Hansen had their new 50-ampere, little vertical welder. I looked longingly at all these, wanting to play with them a little, but none of the boys invited me to try them out. Perhaps it was because they felt that an oxyacetylene man had no business to even deign to look at such things. Or maybe it was that the lads thought that the Old Maestro would wax overenthusiastic about them and in so doing give them too much free advertising and that is something which all manufacturers dread having. "Chuck" Phillips (The C.E. Phillips Co. of Detroit and Chicago) was there with many of his gang and Stoody products, and showed the Stoody rods, some of which now come in 14-in. lengths.

These welding conferences are great stuff. Here's hoping we see more of 'em and bigger and better ones as the time goes by.

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Intimate News of the Industry

A certain handsome acetylene peddler, who is quite the man about town in Pittsburgh, recently had neuritis and hasn't been able to get a date with THE girl friend since. The neuritis was in his arms, so guess wherein his power lay.

I wonder where the red headed gentleman from Fort Wayne had his picture taken.

Rumor has it that E.N. Stevens (Steve to youse guys) is hitting his old stride again and doing a swell job of selling in the great Southwest. Would appreciate confirming this report that I might send orchids or something.

Harry Parker, of Columbus, although he has been using a lot of his own oxygen, is getting better and we all hope to have him back on the job before long. This pneumonia is tough stuff for an oxygen manufacturer to have.

Had the great pleasure of being in Huntington, West Virginia, the other day, calling on A. P. Martin, the owner of the Huntington Forge & Machine Co. This company just now is building a new addition to their building. I guess this is the second in two years, or so. Gosh, how it does me old heart good to see men who have the courage to go forward, who feel that things are going to be oke, and who then take the bull by the tail and look the situation right in the face and work a little harder to make sure that they are going to be the way they want them to be.

Which is the more pathetic picture; a horse fly sitting on a radiator cap or a sparrow pecking away at a discarded spark plug, or a salesman spreading lies and throwing dirt at a competitive brother salesman that he hardly knows?

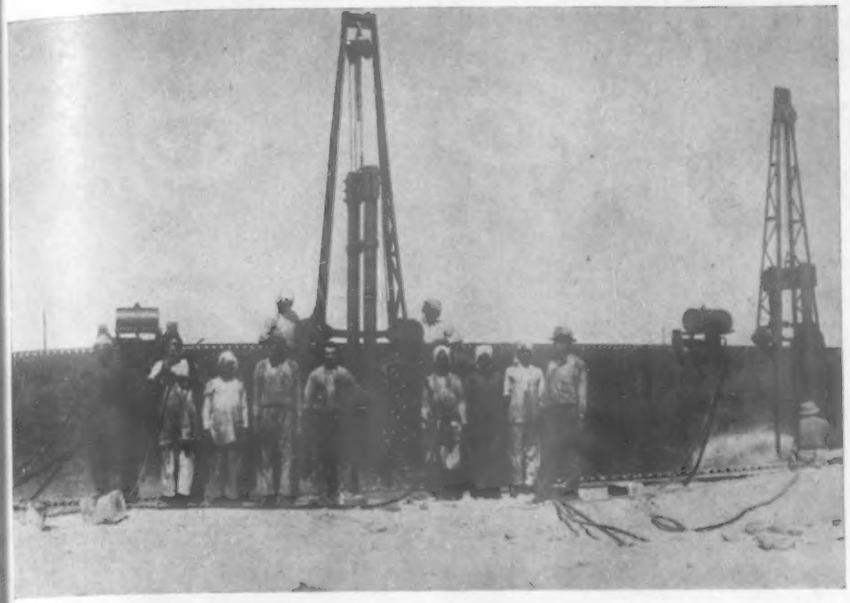
Leonard Rosenberg is no longer selling welding equipment in Cleveland. It is a long story that I'll cut short. The kid had to quit studying medicine after three years because of lack of funds. He fell into the welding industry. On the first of March he got a break. Landed a job which he hopes will lead him to hospital administration some day. And now that he's back with his old love, he is really very happy. Good luck and much success, my hearty, in your new venture.

• • •

The thought for the month: In patience is confidence; in confidence is endurance; in combining these, lies success.

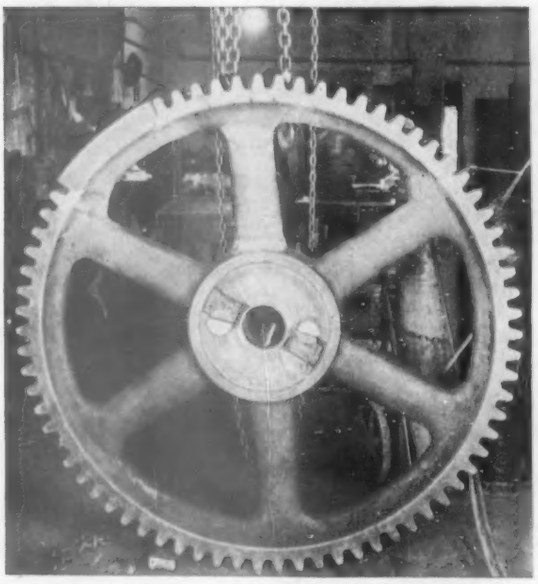
WELDING NEWS IN PICTURES

■ ■ ■

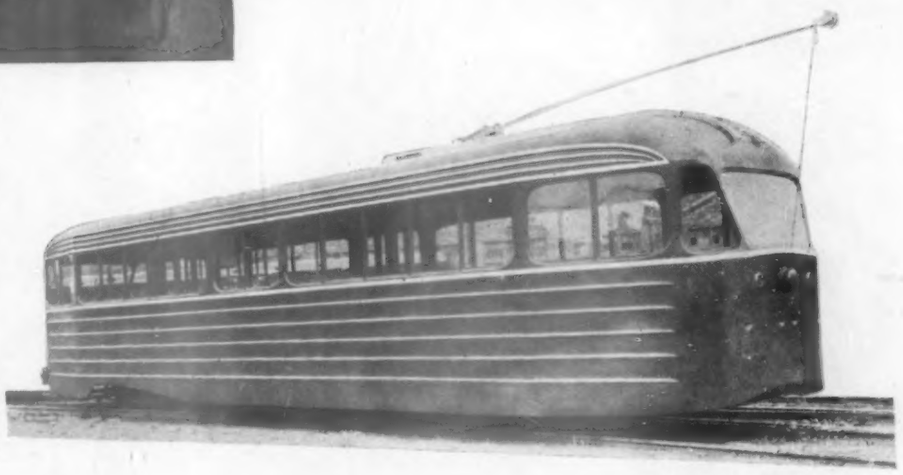


● Americans with native workers engaged in the erection of welded-and-riveted tanks for The Bahrein Petroleum Co., Ltd., on the island of Sitrah, in the Persian Gulf. (See account on page 17, October, 1934, The Welding Engineer.)

● Broken housing of 160-in. plate mill, repaired by thermit welding. Weight, 164,000 lb.; height, 21 ft. 8½ in.; width at base, 14 ft. 9 in. Four tons of thermit required. Job completed in one week.



● This 2500-lb., 7-ft. gear wheel was repaired by arc welding at a cost of $80, whereas a new gear would have cost several hundred dollars. Work done by the Menna Welding Co., Toledo, Ohio. (Photograph courtesy of the General Electric Co.)



● Light-weight trolley car is almost noiseless in operation. Built by welding, in Chicago shops of Pullman Car & Mfg. Co. (Photograph courtesy of The Lincoln Electric Co.)

How Chevrolet Make Their Knee-Action Housings

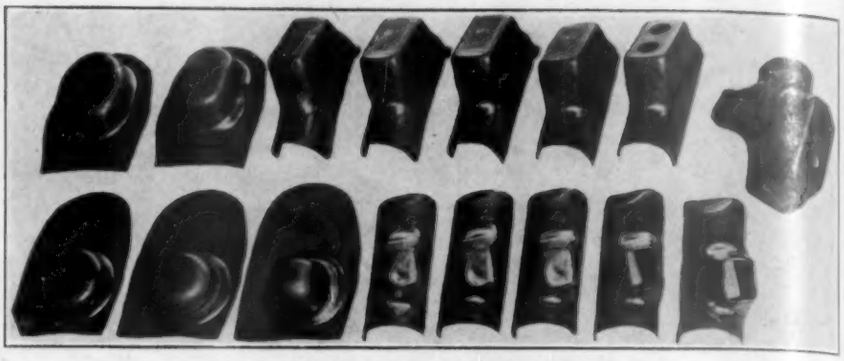
Although Chevrolet's 1935 knee-action units are virtually unchanged from the 1934 models, nevertheless, Chevrolet manufacturing authorities rate the current units as greatly improved over last year's because of refinements in machining, inspecting, and testing.

As a single example of improved results in manufacture, it is stated that the compressed-air test to detect leaks in completed housings now shows but one in every twenty requiring correction.

The use of machines specially designed for the job has bettered the product at almost every stage of its manufacture, while a complete system of gauging in progressive steps stops defective work at whatever stage of completion it has reached, so that no operations are performed on parts that will have to be rejected later.

Housings are formed from 5/32-in. sheet steel. Four sets of dies are required—a set for each half (front and rear) for the left-side unit, and a set in reverse shape for the right-side unit. The preliminary operations are blank and draw, reduce, first form, finish form, and trim. The pieces are then sized in a 300-ton coining press, which squares up and straightens the edges so that there shall be accurate alignment and close contact between the halves in the welders. The liberal use of coining presses at this and subsequent steps of manufacture is credited with much of the improvement over last year's work. Coining presses are used wherever possible to insure exact shape and size in the parts, for accuracy either in welding or in the alignment of bushings, brackets, shock absorbers, etc., to be attached.

The first welding operation is to affix the small inside shock absorber reinforcement in the front half of the housing, after which the face on which the two shock absorbers are to be seated is trued up in a coining press, then smoothed by grinding.



Front and Rear Halves of Housing.

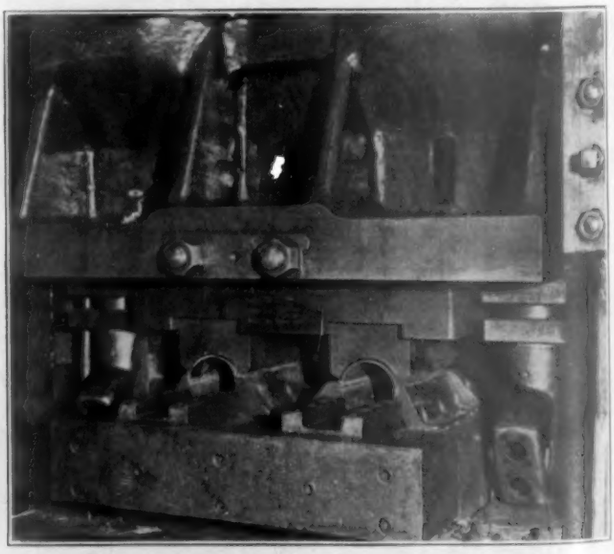
(Here are the halves of the left-hand unit showing the successive operations; a similar series in reversed form is required for the right-hand unit. The bottom row shows the rear half as it develops through 8 operations—1, blank and draw; 2, reduce; 3, second reduce; 4, first form; 5, finish form; 6, size; 7, pierce; 8, trim. The front half (top row) operations are the same except that it is reduced but once. The welded housing shows the pair of shock absorber holes and a main bearing hole in the front half. The rectangular opening in the rear half is for welding to the steering knuckle forging.)

Specially designed Taylor-Winfield welders are used to join the two halves of the housing. Eight of these machines have been installed. The welder, powered by a 5-hp. motor, is equipped with a Reeves variable-speed control. The operator (one to each machine) inserts the two halves in horizontal position, with the open ends toward the front of the machine, then closes the flash guards (the machine will not operate if they are left open), and pushes the starter-button. The sequence and timing of operations are entirely automatic. The movable head is advanced by adjustable cam action, which first brings the edges of the parts in full contact and then regulates the pressure on the edges during the welding, to assure correct finished size. The arc is formed entirely around the two sections—a length of 26½ in.—by a potential of 440 volts, supplying 900 amperes flash and increasing to 2000 amperes. The machine forms a weld remarkably uniform in density, with a minimum of flash material requiring removal. The flash is trimmed off in a vertical press, which shears the excess metal from the exterior of a pair of housings in horizontal dies, at the same time broaching the welded seam inside two other housings.

A new method of removing fused particles or sparks from inside the housings makes use of circular wire brushes, slightly larger in diameter than the cylinders, running at high speed on horizontal arbors. Two coining operations follow, one to flatten the circular bottom of the cylinder to insure proper seating of the radius arm attachment, and another to insure roundness of the open end for boring and threading.

Steering knuckles are welded to the extruded projections on the housing in

Both Halves of the Housings Are Joined in Specially Designed Welding Machines.



Removing the Flash Formed by Welding.

(At each stroke the machine shears the welding flash from the exterior of two housings and broaches the interior of the pair previously trimmed outside.)

a battery of electric welders. The housing is then subjected to its first underwater test, which utilizes air under 15-lb. pressure to reveal any leaks.

The housing is then inverted over an upright with the steering knuckle against a block of live rubber, then rapidly vibrated by blows from a 40-lb. pneumatic hammer. This test not only reveals faulty welding, but aids greatly in cleaning by shaking free any remaining spatterings from the welder.

Re-arrangement of the conveyor line has brought improved results in the welding of main-shaft-bearing bosses to

Making Under-Water Air Tests for Leaks.

the housings. An arbor carrying two bosses is inserted through the housing, and the entire assembly then rotates in the electric welder, which makes a 360° weld around each bushing. The conveyor line that brings the work to the welders extends some distance beyond the machines and doubles back to return to them. The arbor is allowed to remain in the housings loaded on the conveyor, and serves to hold the bushings in alignment while the parts are air-cooled. As they repass the welders, the arbors are withdrawn from the housings.

After another inspection, the housings pass through a normalizing oven (two hours at 900° F.). The bearings are then realigned, if necessary. Another water test follows, this time testing the additional welds around the bushings.

Both bushings are next diamond-bored in a new machine that handles a right- and a left-hand unit at the same time. Next, the top reinforcing ring is reamed and chamfered, and the exterior thread space is turned.

Four rotary washing machines utilizing high-pressure jets of hot water impelled by live steam are used to remove particles loosened by the wire brushes. The cleaning is completed by blowing out the housings with a jet of air under 90-lb. pressure. The housings are dried, then their inside surfaces are sprayed with a lacquer to fix any particles that might become detached in service.

The improved fixtures by which the housings are positively aligned during the broaching of the king-pin holes in the steering knuckles have resulted in a very close finish, and consequent improvement in front-wheel alignment. Under the new method the holes can be held to an accuracy of 0.005 in. Finally, the top of the housing is threaded to receive the cap.

The housing, now complete, undergoes a thorough inspection of every surface, inside and out, being stood up over an aperture in the bench through which is projected a beam of light, which permits the interior to be viewed clearly through the openings for the shock absorbers. After again being washed and blown out with compressed air, the housings undergo a final water test. Those that are O. K., and those that have been corrected by hand-welding, are then hung on the conveyor line to be carried to the knee-action assembly section.

Japan Announces Metal Industries Exposition

A Metal Industries Exposition will be held in the Commercial Museum in Osaka, Japan, on May 10th to 31st, under the joint auspices of AGNE (publisher of the *Journal of Metals*) and The Nikkan Kogyo Shinbun-sha (*The Daily Industrial News*). Exhibits will be shown of castings, rolled metals, forgings, extruded shapes, welded metals and equipment, heat-treated products, raw materials, ores, refined metals, machines and tools for the metal industries, and other displays. All nations are invited to take part. Further information can be obtained from AGNE, Okamoto nr. Kobe, Japan.

Philadelphia Section Hears Talk on Shipyard Welding

"Control of Welding in Shipyards," a paper by Harry W. Pierce, welding supervisor, New York Shipbuilding Corp., Camden, N. J., attracted an audience of more than one hundred to the meeting of the Philadelphia Section of the American Welding Society held on Feb. 18th in the auditorium of the Engineers Club of Philadelphia. The rapidly increasing use of welding in ship construction and the prospective demand for additional thoroughly trained, skilled operators in this type of work, were among the points covered. A discussion of the paper was led by Thomas M. Jackson, electrical engineer, Sun Shipbuilding & Dry Dock Co., Chester, Pa.

Some of the members of the Philadelphia Section took advantage of a general invitation to attend a meeting of the Philadelphia Section of the Association of Iron and Steel Electrical Engineers on March 2nd, at which H. J. Bowles, welding supervisor of the Bethlehem Steel Co., Bethlehem, Pa., read a paper on "Progress of Electric Welding in the Steel Industry."

Detroit Section Holds Joint Meeting With Metal Group

The Detroit Section of the American Welding Society and Detroit Chapter of the American Society for Metals held a joint meeting at the Hotel Fort Shelby on Feb. 11th, at which the group was divided into two sections: ferrous and non-ferrous. The former was addressed by Robert E. Kinkead, consulting welding engineer, of Cleveland, Ohio, on "Training Engineering Personnel in Welding," while the non-ferrous section heard a talk on "Soft Soldering," delivered by S. Turkus, manager of the Newark, N. J., plant of the Federated Metals Corp. The meeting was preceded by a dinner, at which Dr. Henry A. Luce spoke on "Social Medicine in Relation to Industry."

New Plant to Have Nine Welded Buildings

Acquisition of a 70-acre site for the new Diesel-electric locomotive plant to be constructed by the Austin Co. of Cleveland for the Electro-Motive Corp., General Motors Corp. subsidiary, was assured recently when the Illinois Commerce Commission authorized sale of the property by the Indiana Harbor Belt Railroad Co. The site is in McCook, Ill., in the Chicago industrial district.

The plant will be the first complete factory for the exclusive manufacture of Diesel electric locomotives in the country. These locomotives will be powered with Winton Diesel engines manufactured in Cleveland by the Winton Engine Co., another General Motors Corp. subsidiary.

Nine buildings will be included in the plant, which is to be of steel, concrete, brick and glass construction. All of the 2000 tons of structural-steel framework will be welded in the shop and field. This, according to G. A. Bryant, Jr., executive vice-president of the Austin Co., represents an unusual application of welding to heavy structural work.

The erecting and machine shop building, the largest of the group, will be 550 ft. long by 170 ft. wide. It will have a 104-ft. clear span, 49 ft. high, and will be served by one 200-ton and two 30-ton electric traveling cranes.

A three-story, air-conditioned main office building will be of modern design throughout.

The other structures will include an employment office, blacksmith shop, annealing ovens, sand-blast building, paint shop, warehouse and power house. Construction will include building of roads into and around the plant and the laying of extensive railroad trackage.

Examinations for Boiler and Hull Inspectors

Competitive examinations for boiler and hull inspectors, Bureau of Navigation and Steamboat Inspection, have been announced by the United States Civil Service Commission, Washington, D. C. Applications must be filed not later than April 15, 1935. The entrance salaries for local inspectors are $3,200 per year, and for assistant inspectors, $2,900 per year, these salaries being subject to a 3½% deduction. Applicants must have had specified experience. Further information can be obtained from the Commission or from postoffices of the first or second class or customhouses.

Rules to Avoid Explosions in Welding or Cutting of Tanks

Procedures to be followed in preparing for welding or cutting certain types of containers which have held combustibles, are given in tentative recommendations issued recently by the American Welding Society, 33 West 39th St., New York, N. Y. These regulations cover containers where the inflammable substance is either soluble or insoluble in water. In the case of insoluble substances, various methods of purging are described, including the use of nitrogen or carbon dioxide, the hot-chemical solution method, and the steaming method. A recommended method for sampling and testing the gas is given.

Welding Demonstrations at Railroad Show

A number of interesting welding demonstrations were in evidence at the exhibit of the National Railway Appliances Association, held in the Coliseum, Chicago, March 11th to 14th.

An actual demonstration of manganese welding on crossings was given by the Hollup Corp. The Harnischfeger Corp. had a welding booth for the demonstration of arc welding, and the Air Reduction Sales Co. gave demonstrations of Aircowelding, and had on display welding and cutting torches and Wilson welders. The Metal & Thermit Corp. had a display of thermit-welding equipment for the butt welding of rail ends, which attracted a great deal of attention. The Oxweld Railroad Service Co. also had a display of their equipment.

A Welding Engineer's Wife Speaks Her Mind

■ By ONE OF 'EM

Flying Trapeze

We had a 15-minute telephone chat one day last week with Arthur H. Friese, president, Welding Engineering Co., Milwaukee. He was at our local airport, just in from Chicago, bound for Detroit. Mr. Friese is the Wiley Post of the welding industry. He gets from place to place on business errands in nothing flat, by using a combination of all known transportation methods except hitch-hiking.

We learned a little about some work Mr. Friese's company is doing. For the last six weeks they have been wrestling with a welding job that is a honey. The job was to arc-weld a crimped joint in a 24-gauge stainless-steel milk dryer for a Milwaukee dairy. This dryer was elevated 15 feet above the floor, and extended above that for 15 to 30 feet more. The operator had to be eased through a manhole in the top and then let down by cables to scaffolding also hung from steel cables. All of this equipment had to be let down each midnight and pulled up again about nine the next morning so that milk drying could go on during the day. Some other concerns and processes had been tried out on the job but had failed because the difficulties of working overhead at welding heat inside a closed vessel with fiercely reflecting surfaces had proved too much for the operators, game though they were. Mr. Friese, when shown the job, believed the work could be done with the arc process, and sent out a good operator. The man lasted a week before he decided that he couldn't take it. Next, Mr. Friese got hold of another good welder who had been idle for a long period and was glad to tackle the job. Although warned it was tough, he said he could do it. And he did, but he had many fits of discouragement which were successively overcome by substantial increases in his pay. One day, when the job was within a few days of completion, the man quit. The heat and the glare and the necessity for keeping his balance on that swinging perch with a shield over his face, had got him down. Also, he wanted still more money. He went home and wrote Mr. Friese a letter:

Dear Boss: As I have not here from you I take it for granted you are leaveing the money as it is so I gest the best thing I can say is you better sent somebody goddam quick and finish job. You say I was out of work for a long time wel if I fall off this flying Trappes I will be out of work a dam long time O. K. Boss for God sake send some one Wenday sure. And I will show him everything good if you care for this information. This sure is a hell of a place to work. I guess you think I am nuts or something or I am putting on act for ripley at Chicaggo fair or something. People should pay good money to see this act in this dam tea kettle.

Mr. Friese got the fellow calmed down and organized once more, and the job was successfully completed.

At present the company is engaged in repairing two large brewery tanks by are welding, and has several gas-engine-driven outfits busy on ship repairs. Mr. Friese reports good business as well as a favorable outlook for spring in his territory.

* * *

For Married Men Only

Latest aid to wedded bliss is the "grouch house." This may be a shack in the back yard, an attic den, or a partitioned corner of the basement. The important thing is to keep it padlocked, because it is usually a very popular place and, besides, your wife will always be wanting to clean it up, and that spoils the fun. A "grouch house" is a place where a man can be alone and do as he pleases at those times when he needs to be by himself.

It should never be fancy. The ideal grouch house is a one-room shack out beside the garage. You men can nail one together some week-end out of old lumber. Don't worry about not knowing how; just get out with a hammer and some boards and the whole neighborhood will be over in a jiffy to give you advice. Some of it may be good, so when you get your shack built, put in some kind of a bunk and a table, and there you are, all ready to throw ashes on the floor and have a good time. Some men I know like to read their detective magazines out there to escape the family wise cracks about the literary rubbish dad reads. Others have a little radio, provided they have gone ahead and wired the place, and some like to make things with tools in the grouch house. Again, some may merely like a place to be quiet when the wife is having her club or the children are having orchestra practice in the front room.

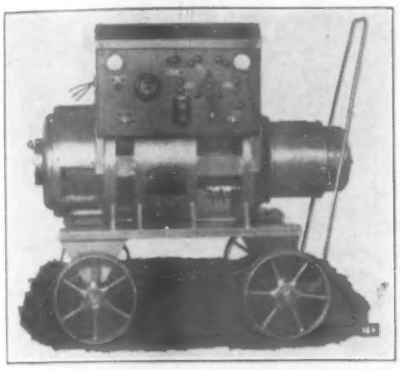
If you built your retreat in the basement, you may want to have a bar. One is not necessary, of course, to set out the beer for the stag poker, but it is fun to have one. In the stores they show very stylish ones made of stainless steel, that set you back as much as a hundred dollars. You welders can make one, and with a footrail of stainless-steel tubing, for a small outlay. Of course, if you want to get arty and paint designs on it in colored enamel, like those in the stores, why go to it and God bless you, but the plain sheets are very good-looking indeed. In any case, you can have a lot of fun with one in your basement grouch house and you can depend on it that your friends will be pestering you to make them one just like it.

What's New in

Equipment and Accessories

New Welder Designed to Give Steady Arc

The New Universal Staid-Arc Welder gives steady, dependable performance, says an announcement from the manufacturer, the Universal Power Corp., 1719 Clarkstone Road, Cleveland, Ohio. Some 600 welding-current settings are available. The machine is said to deliver easily



Universal Staid-Arc Welder.

its full welding range under the proposed NEMA standards, whether it is started cold or thoroughly warmed up in heavy welding service. The whole unit is ruggedly built to withstand hard use.

New Portable Type of Gun Spot Welder

A mobile welding machine, consisting of a welding gun operated by a single push-button switch, and a compact portable steel cabinet containing all the transforming, regulating, contacting and timing apparatus, has been developed by the Thomson-Gibb Electric Welding Co., of Lynn, Mass. It can be used on a wide range of work now handled by stationary spot welders and can be applied to work that is too bulky to move or on which the parts to be welded cannot be reached by stationary machines. It is particularly adapted to assembly-line production or to work fabricated in jigs.

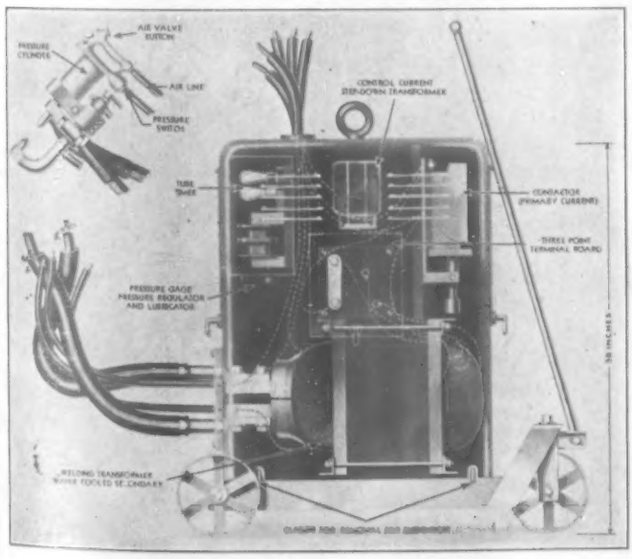
The machine is equipped with a demountable truck and a heavy lifting bolt so that it can be wheeled to the work or suspended on a traveling hoist. The power transformer, step-down control transformer, heat regulator, contactor, weld timer, air regulator and gauge are all housed in the cabinet. No outside connections for special low-voltage control circuits, contactors or timers are needed. All controls are conveniently located inside the cabinet.

A special over-size transformer supplies a large volume of current for short intervals, and a weld timer breaks the circuit the instant the weld is completed. Welds take only 1/20 to 1/3 of a second, which is too fast to heat the leads or electrodes, thereby eliminating the need for artificially cooled leads.

The standard welding gun can be fitted with a wide variety of interchangeable water-cooled yokes. The yokes are made of special heavy-wall copper tube fitted with hard-copper-alloy welding tips. They are available in a number of standard shapes, and special arrangements can easily be designed to suit specifications.

A built-in pressure-operated limit switch automatically applies the current when the pressure in the air cylinder reaches a predetermined amount. It can be set to trip at any required air pressure. This automatic switch, and the weld timer which controls the current, speed up the operation of the gun and increase the number of spots that can be produced per minute.

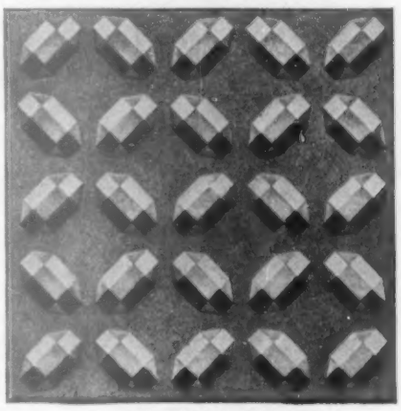
The unit illustrated can weld clean metal up to 16 gauge, and the gun can be fitted with yokes having throat depths up to 12 in. Guns, yokes and complete transformer equipment are available for heavier work or work requiring larger throat depths.



Phantom View of Gun-Type Spot Welder, Showing Arrangement of Parts.

Floor Plate of New Design Prevents Skidding

"Multigrip," a new floor plate, was recently announced by the Illinois Steel Co., 208 S. La Salle St., Chicago, Ill. The design of this plate was developed by long experimentation to assure a high degree of skid resistance from every angle. It is also said to be very comfortable under foot, for while it offers a



One-Half Actual Size

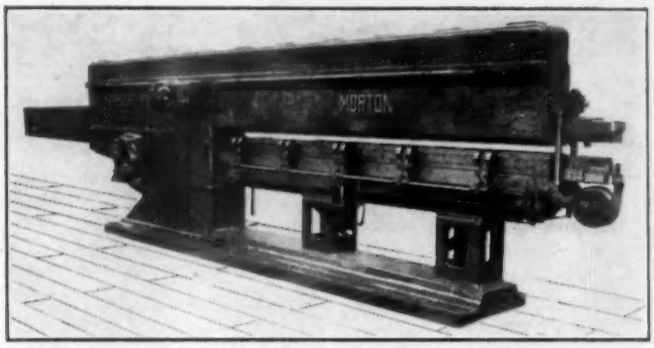
Anti-Skid Floor Plate.

sure tread there are no sharp protuberances. All lugs have a flattened top surface. It can be cleaned readily and drains freely. There are no pockets in which water can accumulate. Its symmetrical design minimized waste in cutting. The plate is rolled from open-hearth steel and lends itself readily to forming, bending or even the most complicated fabrication. Standard sizes include six thicknesses ranging from 3/16 to ½ in., and various widths from 6 to 84 in. and lengths of 120, 240 and 480 in., depending on the width.

Cleans Flash From Sheets Up to 10 Ft. in Length

For trimming the flash from butt-welded sheets having a seam up to 120 in. in length and with thicknesses down to 20 gauge, a machine has been especially designed by the Morton Manufacturing Co., Muskegon Heights, Mich., and is shown in the illustration.

The upper ram is raised and lowered by eccentrics equipped with roller bearings. Hardened-steel-lined dies are secured to the ram housing member, and



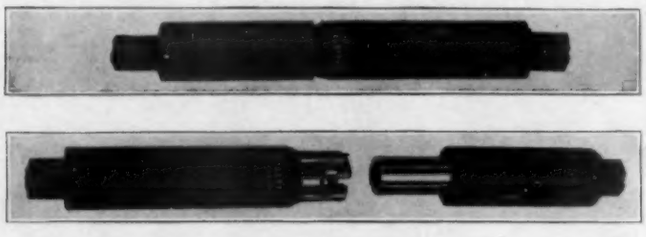
Machine for Trimming Flash From Butt-Welded Sheets.

the rams and cutting tools travel in a path parallel to the hardened die surfaces. Automatic compensation of the upper ram takes care of variation in metal thickness. Provision for clamping the dies 2 in. apart makes for ease in entering and removing the work. Power is applied to the two reciprocating rams by means of a reversing-type motor. The cutting and return speed is approximately 60 ft. per minute. A series of cutting tools are securely fixed in the rams by means of adjustable tool holders.

A unique feature of this machine is the die-cleaning and centering method. With semi-automatic operation, the work unclamps as soon as the cutting rams reach the inward position, and the work can be removed while the rams are returning to their initial position. With the rams in their outer position, a blast of air is automatically blown across the dies to free them from dirt. A solenoid-operated centering and lighting device within the upper ram makes it possible to center the sheet very accurately with the die.

Cable-to-Cable Connections Made Quickly and Easily

A connector for welding cables, by means of which the cable sections can be quickly attached and detached, has been developed by The Dallett Co., 176 W. Clearfield St., Philadelphia, Pa., and is sold under the name of Dalweld Detachable Cable Connector. Only a quarter turn of the connector is required to connect or disconnect the cable. These connectors are said to insure against accidental grounds or exposure of live parts, since they cannot be accidentally disconnected, and all metal parts are fiber insulated. The expander-type plug is said to insure a wipe-joint fit, plus large area contact and maximum conductivity with any size of cable or amperage employed in welding. The construction is such as to withstand very rough service.

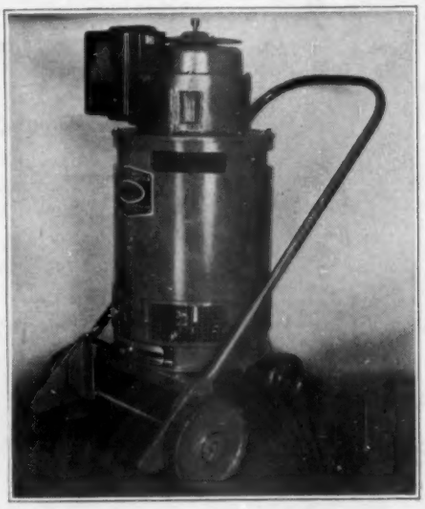


Cable Connector, Shown Connected and Separated.

50-Ampere Generator for Light Welding

Answering the need for a low-current arc welder capable of handling the lighter-gauge metals used in automobile bodies, etc., the Harnischfeger Corp., of Milwaukee, Wis., has just announced a new P&H-Hansen 50-ampere vertical model.

The outstanding feature of this new welder, known as the W50-254, is said to be an extremely stable high-speed arc which enables it to weld quickly and efficiently down to 26-gauge steels. No external reactors, resistors, or separate stabilizers are used; the self-stabilized



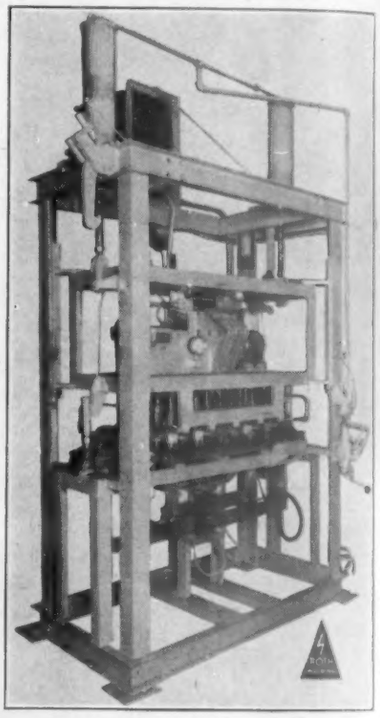
Small-Capacity Vertical-Type Welder.

arc is achieved through the use of an exclusive internal stabilizer winding. Being a motor-generator unit with a 3-hp. squirrel-cage motor, it operates on any alternating-current power line, including 110-volt single-phase. With current control simplified to a single adjustment dial at the top of the housing, it is ideally suited for welding of ferrous and non-ferrous metals in general repair work or for the fabrication of containers of stainless steel, phosphor bronze, aluminum, etc., with the metallic arc.

This new welder is of vertical or upright design, requiring less than 2 sq. ft. of floor space. It is 15 in. wide and 36 in. high and is supplied with a base for stationary mounting or with wheels or lifting bail for easy handling around the shop.

Automatic Spot Welder Can Make Five Welds a Minute

A new type of full-automatic spot-welding equipment, especially developed for the requirements of the automotive and similar industries, is being marketed



Spot Welder Consisting of Many Individual Welding Units.

by the Roth Welding-Engineering Co., 1163 Harper Ave., Detroit, Mich. This new welding method is adaptable for any welding job wherever a number of spot welds in various fixed locations have to be performed on steel panels. No matter how complicated the shape of the panel, it is possible to exactly locate the spot welds and secure extremely short welding time for the total number of welds, it is claimed.

A number of individual hydromatic welding units are mounted in a fixture in correct location (vertical, horizontal, or any angle which may be required), and a full-automatic master control unit with multiple valves operates the individual hydromatic welding guns in rapid succession.

Any number from ten to several hun-

All failed in the parent metal

★

NOT ONE FAILED IN THE WELD

★

LABORATORY inspected cast-iron bars were cut in two, the edges beveled, then welded together with Tobin Bronze . . . and subjected to straight pull strength tests. All failed in the cast iron . . . there were no failures in the Bronze! Tobin Bronze is uniformly dependable—welders like the way it flows, and the tough, strong, durable bonds it produces.

The uniformity of Tobin Bronze is the result of close inspection and the manufacturing skill developed during a century of experience in the production of copper, brass and bronze products.

There are 14 Anaconda Welding Rods . . . a suitable one for every purpose. Their characteristics and welding procedures are outlined in detail in Anaconda Publication B-13. A copy will be mailed to you—without cost—for the asking.

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut

ANACONDA
from mine to consumer

ANACONDA WELDING RODS

dred welds may be performed on panels of any size, or even on a complete body. The average speed is from two to five spot welds per second, but it is possible to operate the guns in such a way that two or more spot welds are performed at one time, thus multiplying the efficiency of the machine. Comparatively little electric power is required, it is said, due to the fact that only one or two spot welds are made at a time.

The new method, therefore, can often be used in place of projection welders or portable welders. The company claims that many machines of this type have already been installed in automotive and pressed-steel plants.

The illustration shows a standard Multi-Hydromatic Welding Press, as it is used for welding flat panels.

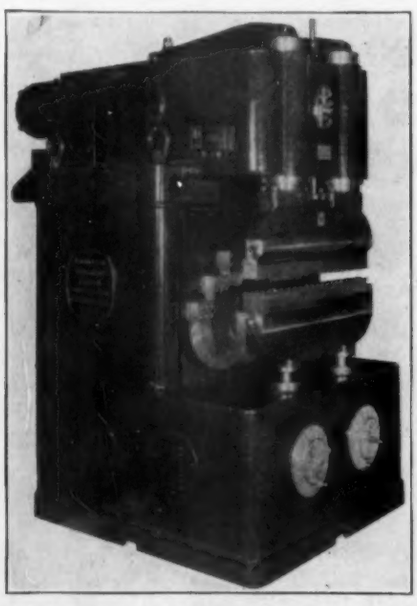
New Type of Monel Metal Has Strength of Alloy Steels

After 12 years of research and development, engineers of The International Nickel Co. have produced a new type of monel metal which combines the strength of alloy steels with the corrosion resistance of regular monel metal.

In analysis the new alloy, known as K Monel, is practically the same as regular monel metal with the exception of about 4% added aluminum and fractional amounts of other elements. It is readily heat-treated, and its fully hardened condition shows Brinell values above 350, though it is available also in softer forms. Its tensile strength runs higher than 160,000 lb. per sq. in.

Welded Steel Used in New Projection Welder

The machine illustrated is a 600-kva. projection welder recently announced by the American Electric Fusion Corp., 2610 Diversey Ave., Chicago, Ill. The main framework and component parts are built up from steel plates, all welded together to form a homogeneous whole. The design is as pleasing as might be expected from any cast construction. The base is 52x52 in., and the height is 88 in. The finished equipment weighs somewhat in excess of 14,000 lb. This welder is capable of making simultaneously 20 spot welds distributed over a space 36 in. long. The rated output of the machine is 1200 welds per minute.



Projection Welder Rated at 1200 Welds per Minute.

Trade Literature

A self-propelled tractor, equipped with a boom—known as a "Krane-Kar" when equipped with pneumatic-tired wheels, and as a "Krane-Krawler" when built as a crawler tractor—is described and a wide variety of applications illustrated in Bulletin 45, issued by the Silent Hoist Winch & Crane Co., 762-772 Henry St., Brooklyn, N. Y. In the absence of overhead cranes, this equipment is convenient for handling castings, sheets, plates, structural sections, etc., and for assembly operations.

"Application of Stoody Products to Agricultural Implements" is the title of an illustrated booklet by the Stoody Co., Whittier, Calif., explaining the opportunities for the job shop in the hard-facing of plow shares, procedures for facing new shares and reclaiming old shares, the making of jigs for holding the work, and procedures for hard-facing cultivator shovels, beet rooters, hand shovels, and dull tools. All instructions are clearly given.

The Milwaukee School of Engineering, Milwaukee, Wis., has issued a 16-page bulletin, outlining in a general way the opportunities in the field of arc welding, illustrating many welded jobs of interest, showing many types of welded joints, with comments, describing the facilities of the school, giving an outline of the arc-welding course taught by the school, and listing the faculty of the Welding Institute.

The "Fasco" Projection welder is illustrated and described in a folder issued by the Fassler Welding Machine Co., 424 Stormfeltz-Loveley Building, Detroit, Mich. This machine employs the construction material as the secondary of the transformer, which is said to insure a high power factor, since the electrical circuit is not influenced by iron masses.

"Specifications for Chrome-Manganese-Silicon Alloy Steel Boiler Plate" is the title of a booklet issued by the Lukens Steel Co., Coatesville, Pa., which is reprinted from the 1934 addenda to the Material Specifications Section of the A. S. M. E. Boiler Construction Code. At present these specifications apply only to riveted or seamless construction.

Koven industrial equipment, made from plates and sheets, in all commercial metals, for chemical, paper, textile, rubber, and other industries, is described and illustrated in a loose-leaf catalog recently published by L. O. Koven & Brother, Inc., 154 Ogden Ave., Jersey City, N. J. A great deal of the equipment illustrated is of welded construction.

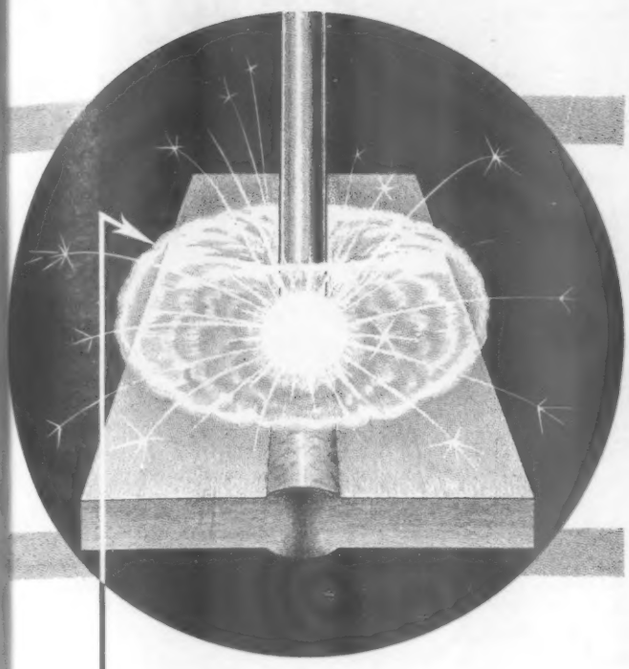
"The New 40-Volt Arc Welding in Large and Small Manufacturing Plants" is the title of a 20-page booklet published by the Hobart Bros. Co., Box U-35, Troy, Ohio, describing some of the wide variety of work done with 40-volt machines and illustrating many interesting examples of welded parts built up from rolled steel to replace castings.

"World's Largest Plate Mill, and Its Products" is the subject of a 4-page folder of illustrations, printed in rotogravure, showing many interesting products rolled and fabricated by the Lukens Steel Co., Coatesville, Pa., or its subsidiary companies. Copies can be obtained from the company.

"Plow Shares Can Make Money" is the title of a 4-page folder describing the benefits to farmers in having their plow shares processed the Stoody way. These folders, supplied by the Stoody Co., Whittier, Calif. to job welding shops, with name imprinted, for distribution to the farming population.

"Carbon Dioxide—The Killer" is the title of an attractive booklet issued by the Mine Safety Appliances Co., Pittsburgh, Pa., describing the physiological effects of carbon monoxide, detection of the gas, protection of the individual, and resuscitation methods.

The Commercial Gas Co., Minneapolis, Minn., has issued a price list of oxyacetylene and electric-arc welding rods and supplies, dated March 15, 1935.



★ THIS ENVELOPING CLOUD

assures a

GOOD WELD!

★ **The requirements for good welding are no different than those required in any other step of your production . . . Quality of materials, speed of application and character of finished work are the important factors. . . . Page Hi-Tensile Electrodes are better electrodes . . . They are pure metal and are heavily coated. . . . This coating provides a small protecting cloud which closely surrounds and shields the arc—spatter loss is less. A larger amount of actual usable weld metal per inch is deposited, the formation of oxide and nitride impurities is prevented, the weld is completely covered, thereby lowering the cooling rate which in turn increases the ductility of the weld metal. . . . Look to Page for better welding and to the Page Engineering Staff for counsel if your welding problem seems to you to be particularly difficult.**

PAGE STEEL AND WIRE DIVISION
OF THE AMERICAN CHAIN CO., INC.

General Sales Office—Monessen, Pa.

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Atlanta—Chicago—New York—Pittsburgh—San Francisco

PAGE HI-TENSILE COATING STEEL
"Shielded Arc"
WELDING ELECTRODES
STEEL AND WIRE PAGE QUALITY PRODUCTS

TWO NEW EXCLUSIVE WILLSON WELDING PROTECTIVE DEVICES

Willson Chip-Weld Goggle Style DC50

This new Willson goggle is for use on jobs where welding, brazing, burning or cutting is interrupted frequently to permit inspection or grinding, flattening and forming work. Much time is saved by simply flipping up the hinged frames which hold the 50 mm. Willson-Weld lenses in place. In the cups under the filter lenses are 50 mm. Super-Tough lenses for protection from flying particles, etc. DC50 is comfortable, well ventilated and can be worn over spectacles when necessary.

Willson Welding Helmet No. 20

Patent applied for

A helmet of durable black fibre with riveted construction in improved design, No. 20 has a flip front glass holder molded of a fine grade plastic composition which will not warp, dent or bend. It is not a conductor of electricity and is unaffected by moisture or extreme temperatures. It is fitted with Willson-Weld glass, easily replaceable and has a comfortable adjustable, three position headgear. The flip front permits frequent, quick job inspection without the necessity of raising the helmet. Send for illustrated circulars; we'll be glad to tell you where you can see these devices in your own neighborhood.

Prices f. o. b. shipping point

Style DC50 Goggle, $4.50 each
No. 20 Welding Helmet $9.90 each

WILLSON PRODUCTS, Inc.

Reading, Pa.

Commercial News

Joins Dockson Company as Consultant on Welding

William Zorn, formerly welding engineer for the Detroit Edison Co., joined the C. H. Dockson Co., of Detroit, Mich., on Feb. 1st, as consulting welding engineer. During his association with the Detroit Edison Co. he was in charge of all welding operations, and recently completed the welding on the main steam lines of new units operating at 650 lb. per sq. in. and 850° F. His experience embraces every phase of metallic-arc welding, as well as atomic-hydrogen welding, and gas welding and

WILLIAM ZORN

cutting, and includes tank and structural welding, welding of high- and low-pressure piping and alloys, hard-facing, etc.

Mr. Zorn has also been connected with the following concerns: Steere Engineering Co., Owosso, Mich.; Hydraulic Pressed Steel Co., Cleveland, Ohio; Van Dorn Iron Works, Cleveland, Ohio; New York Central Railroad Co., Cleveland, Ohio; Universal Machine Co., Bowling Green, Ohio; and Baltimore & Ohio Railroad Co. He has written many papers on welding, having contributed at times to *The Welding Engineer*, and has given many talks before technical societies. He was the writer of the paper awarded sixth prize in the Second Lincoln Prize Competition. He is active in the American Welding Society.

During the war, he served in the Canadian Army, and after the United States entered the conflict, he gave many lectures during the Liberty Loan Campaigns, and lectured on the same subject for Redpath Chautauqua Circuits.

Puritan Compressed Gas Co. Increases Plant Capacities

The capacity of their Kansas City plant has been increased 50%, and a new addition to their Baltimore, Md., plant more than doubles its output, it is announced by Parker Francis, president of the Puritan Compressed Gas Co., Kansas City, Mo. The Baltimore plant is under the management of R. E. Stone and serves both the medical and industrial fields. Ralph E. Koons is manager of the Kansas City district. The floor space of the company's Kansas City show room and service department has also been doubled. This is the only oxygen-producing company having a main-floor show room, says Mr. Francis.

A new lecture room at the Kansas City plant is being used by groups from industrial plants and high-schools for educational talks and motion pictures on welding.

This company has a greater number of employees today than in the boom year of 1929.

Offers 2-Year Night Course for Welders and Engineers

In view of the high interest being shown in the Milwaukee metropolitan area and the Northshore district, in welding and allied fields, the administration of the Milwaukee School of Engineering, 1020 N. Broadway, Milwaukee, Wis., has instituted a 2-year evening course for practical welders and welding engineers. The first course to be offered in this series in on "Metallurgy," and classes will begin on March 25th. As the course progresses, individual courses will be offered on "Welding Shop Methods," "Welding Design," "Electricity," and "Welding Machine Operation."

Ray Tarbell Joins Company Manufacturing New Welder

Ray P. Tarbell, for 17 years connected with the welding industry, has been appointed manager of the Welding Division of The Ideal Electric & Manufacturing Co., Mansfield, Ohio, who recently announced their entrance into the welding field by developing an arc-welding machine. Mr. Tarbell's experience includes 13 years with The Lincoln Electric Co. as sales engineer and district manager, two years with Robert E. Kinkead, Inc., consulting welding engineers, and two years as manager of the Welding Electrode Division of The Babcock & Wilcox Co.

H. O. Westendarp, Jr., Cleveland representative for the General Electric Co., is scheduled to give a talk on "Recent Developments in Electric Welding" before the Toledo Association of Purchasing Agents at the Toledo Edison Co., Toledo, Ohio, on March 21st, and will speak on the same subject before the American Society of Mechanical Engineers at Canton, Ohio, on April 18th. Mr. Westendarp was also on the program of the recent welding conference held at The Ohio State University.

Lukens Steel Co., Coatesville, Pa., announces the appointment of W. A. Hauck as assistant to the president, and Erle G. Hill as director of research. Before joining the Lukens organization, Mr. Hauck was with the American Iron & Steel Institute, engaged in work in connection with the Iron and Steel Code, and prior to that was with George W. Goethals, Inc., and the Bethlehem Steel Co. Mr. Hill comes to Lukens from the Mellon Institute of Industrial Research.

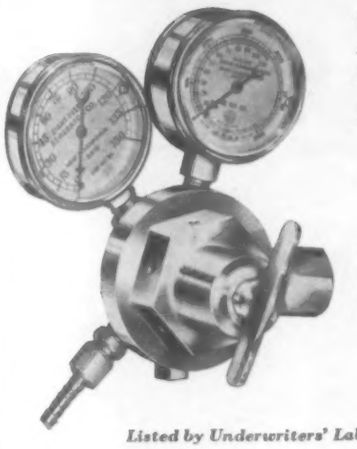
Competing with 91 entries in the Midwest Individual Championship Rifle Matches, held at Columbus, Ohio, on Feb. 23rd, Earl Rinck, an engineer with The Sight-Feed Generator Co., West Alexandria, Ohio, won the match with a total score of 188 out of a possible 200, and was awarded the *Columbus Dispatch* gold trophy. Mr. Rinck also won a trophy in the off-hand match.

The Fassler Welding Machine Co., Stormfeltz-Loveley Building, Detroit, Mich., has been organized for the sale of Fassler designed and built electric-resistance-welding machines. The company has obtained the exclusive services of P. W. Fassler, well-known designer of resistance-welding machines, according to word from Pat. E. O'Connor, vice-president.

Wade Hemperly, of Phoenix, Ariz., formerly engaged in contract hauling, has organized the Welder Supply Co., at 920 South 7th St., Phoenix, and is handling Torchweld equipment and Shawinigan carbide. He is seeking exclusive distribution for a line of rods and electrodes, welding helmets, and other accessories.

Students from as far away as Argentina (South America), Manitoba (Canada), Oregon and Connecticut are at present enrolled in the Cleveland School of Welding, Cleveland, Ohio. The present enrollment sets a new record for

guaranteed *unconditionally*



Two Gauge SF Super Safety Regulators

$20.00

Single Gauge SF Super Safety Regulators

$15.00

Listed by Underwriters' Laboratories

. . . and *unconditionally* means just what it says! The new SF Super Safety Regulator is guaranteed to perform to *the satisfaction of the user* for a period of one year!

This revolutionary SF Super Safety Regulator is of an entirely new design. Although of single stage construction, *it is guaranteed to equal any two stage* regulator in performance.

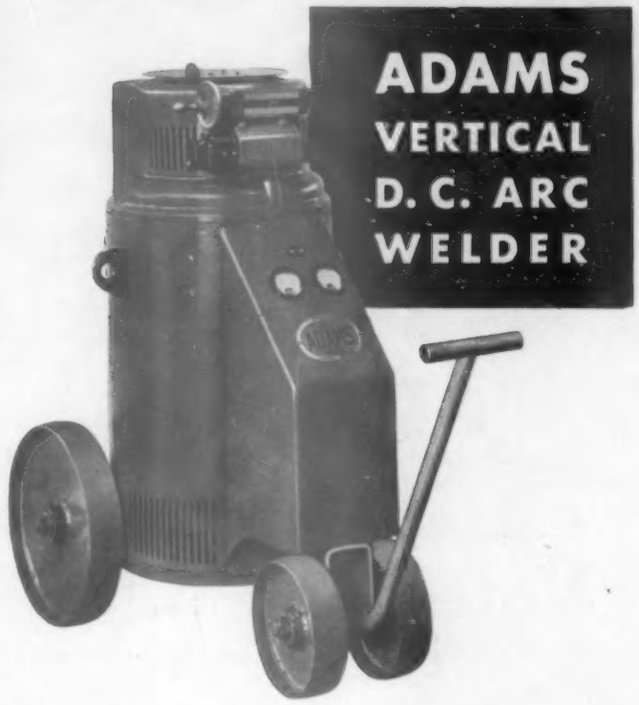
An extremely sensitive, three inch, shearing type, clamped metal diaphragm . . . together with a radically new design of body, having an exceptionally large bowl . . . makes possible a finer regulation of both volume and pressure than was previously thought possible.

Double safety features . . . the shearing diaphragm and a safety plug of a new design . . . prevent any damage in the event excessive pressures are built up. Positively non-freezing.

Highest quality 2½-inch gauges are guaranteed free from defects in material or workmanship for one year.

Available for use with oxygen, acetylene, hydrogen, butane and other compressed and liquefied gases. *Ask your SIGHT FEED Distributor about the plan to save you 75% of your regulator and acetylene cost.*

The Sight Feed Generator Co.
Richmond, Indiana



Offers These Advantages

In Vertical Design:

Gyratory Action which reduces vibration and commutator wear.

High Air Intake with horizontal discharge, which reduces pickup of metallic and abrasive particles destructive to windings.

Low Center of Gravity providing easy handling either on floor or by crane.

Requires Small Floor Space (30″ x 42″ for 400 Amp. Machines.)

In Electrical Design:

Interpole Stabilizing Windings which insure uniform current flow, hence uniform welding characteristics.

Dual Excitation from Commutator providing instantaneous arc recovery and snappy, smooth welding action.

Micrometer Current Control providing accurate current adjustment over unusually wide welding range.

Liberal Design of active iron and copper providing overload capacity without overheating.

Investigate this new outstanding Arc-Welder which is giving such complete satisfaction to users who demand highest quality and wide range service. Available in 200, 300, and 400 Amp. sizes NEMA ratings.

•

J. D. ADAMS COMPANY
Arc Welding Equipment and Electrodes
INDIANAPOLIS, INDIANA

distance from which students have come, says Edward Scott, president.

The American Agile Corp., Cleveland, Ohio, announce the appointment of the following jobbers for their line of electrodes: Commercial Gas Co., Minneapolis, Minn.; Minot Supply Co., Minot, N. D.; Auto Equipment Co., Denver, Colo.; and J. B. Hill, Detroit, Mich.

The Dominion Oxygen Co., Ltd., have removed their general offices from 92 Adelaide St. West to the seventh floor of the Commerce & Transportation Building at 159 Bay St., Toronto 2, Canada.

The Metal Bond Manufacturing Co., St. Louis, Mo., are making extensive alterations to their factory, which will increase their floor space by one-third, and are remodeling the office.

H. G. Larisch, who was formerly connected with the Torchweld Equipment Co., 1035 W. Lake St., Chicago, Ill., for 14 years, is now working for the company out of Cleveland, Ohio.

H. G. Wallis, who has been handling welding sales at the Kenosha, Wis., branch office of The American Brass Co., has been made assistant branch manager at Kenosha.

R. W. Vinke, of the Chicago district office of the Air Reduction Sales Co., has been promoted to the position of assistant sales manager of that office.

Notes From the Field

Eleven thousand tons of steel, much of which was welded, recently went into the erection of the plant of Hughs Mitchell Processes, Inc., of Torrance, Calif. This concern will produce various compounds of lead and zinc obtained from complex lead-zinc ores. The contract for the structural work, including welding, was awarded to the Consolidated Steel Corp., Ltd., of Los Angeles.

Tom P. Flynn, W. R. Neighbor and G. H. Brant, all welders of many years' experience, have combined forces under the firm name of Denver Welding Shop. Articles of incorporation were filed Feb. 20th, and the three men opened their shop on S. Broadway, Denver, Colo., with a satisfactory volume of business already built up through their previous individual activities.

The J. G. Hunt Co., Long Beach, Calif., welding specialists in car and truck body and frame work, announce that they will soon start production on a new type of trailer known as the "Caster Wheel Trailer." It will have but one wheel, operating on a swivel much the same as a caster on a bed leg. Much of its construction will be by arc welding.

The Standard Dredging Co., of Long Beach, Calif., will employ electric welding extensively in a dredging contract in the near future at Balboa Beach. A large P&H-Hansen welding unit has been rented for a period of three months, to be used in welding pipe, together with general maintenance and repairs on the project.

The Auburn Machine Co., Fred Schmidt, owner, of Auburn, Nebr., has received government contracts in connection with work on the Missouri River between St. Joseph and Omaha. This work will probably keep Mr. Schmidt's crew busy for the next six months. Mr. Schmidt recently purchased two arc-welding machines.

A large government welding contract was recently completed by the Davenport Mfg. Co., of Los Angeles, Calif., in the construction of 235 all-welded drag-type grading scrapers for the Reclamation branch of the U. S. Department of the Interior. Fifteen units of the 5-yd.-capacity type were also built by this concern.

The Williamson Garage, of Sante Fe, N. M., has moved from 310 Water St. to a site on the Sante Fe camp ground. The shop, which is operated by W. E. and R. J. Ham, has installed a new welding generator and plans to go after welding business on a more extensive scale than formerly.

"Magnetic Flare and Arc Blow in Arc Welding" was the title of a paper read before the Cleveland Section of the American Welding Society on March 19th, by Robert Notvest, welding engineer, J. D. Adams Co., of Indianapolis, Ind. Mr. Notvest accompanied his talk with lantern slides.

In making heavy repairs on railroad gondolas in the Beech Grove shops of the Big Four Railroad at Indianapolis, Ind., the sheets riveted to the inside of the framing are removed and then are welded to the outside of the frames, thereby increasing the cubical capacity of the car.

W. W. Kelly, proprietor of the Anchor Welding Co., 239 North 11th St., Lincoln, Nebr., reports that during the cold weather when outside work is a little slack, he engaged in the repair of steel wheelbarrows for contractors. Mr. Kelly says his business has increased 20% since Jan. 1st.

The Aramingo Welding Co., Inc., of Philadelphia, Pa., has moved from 1130 N. Delaware Ave. to 1411 Frankford Ave. Owing to a tremendous increase in business, it was necessary to take larger and better quarters. B. I. Gamble and Geo. Bastian are proprietors.

Walter J. Thomas & Co., 15120 Woodward Ave., Detroit, Mich., have reorganized and are now operating under the name of the Thomas Welding Laboratories, Inc., according to an announcement from Walter J. Thomas, president.

T. M. Frew, Jr., welding shop owner, of Newhall, Calif., recently took over the shop following the death of his father a few months ago. His father had operated the only blacksmith and welding shop in the town for the past forty years.

The Pacific Iron & Steel Co., of South Compton Blvd., near Compton, Calif., has been awarded a contract for a large amount of welding in earthquake-reinforcing steel work in the Polytechnic High School in Long Beach.

L. J. Peters, of the Peters Welding Works, San Diega, Calif., is in Mexico on an equipment-maintenance contract for the National Construction Co., which concern is building several miles of highway below Tia Juana.

Bids are soon to be asked by John A. Roebling's Sons Co., for the construction of a one-story steel cable-spinning plant, to be erected in California City, Calif. The plant will be 535 ft. long by 100 ft. wide.

The Electric Cutting & Welding Co., of Bell, Calif., is being moved from the old location at 7506 Atlantic Blvd. into larger and more convenient quarters across the street, at No. 7519.

Nebraska state road projects call for the building of about forty steel bridges and overpasses during the current year. That means more work for the shops with electric portable welders.

Jack Cox and Otis Woods have opened a new boiler and welding shop in the Ada, Okla., oil field, which will operate under the name Cox & Woods. They have purchased new equipment.